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ATMOSPHERIC MONITORING FOR TRANSPORTATION EMERGENCIES.

VOLUME 1: DEVELOPMENT OF A PRIORITY CHEMICALS LIST.

1981.

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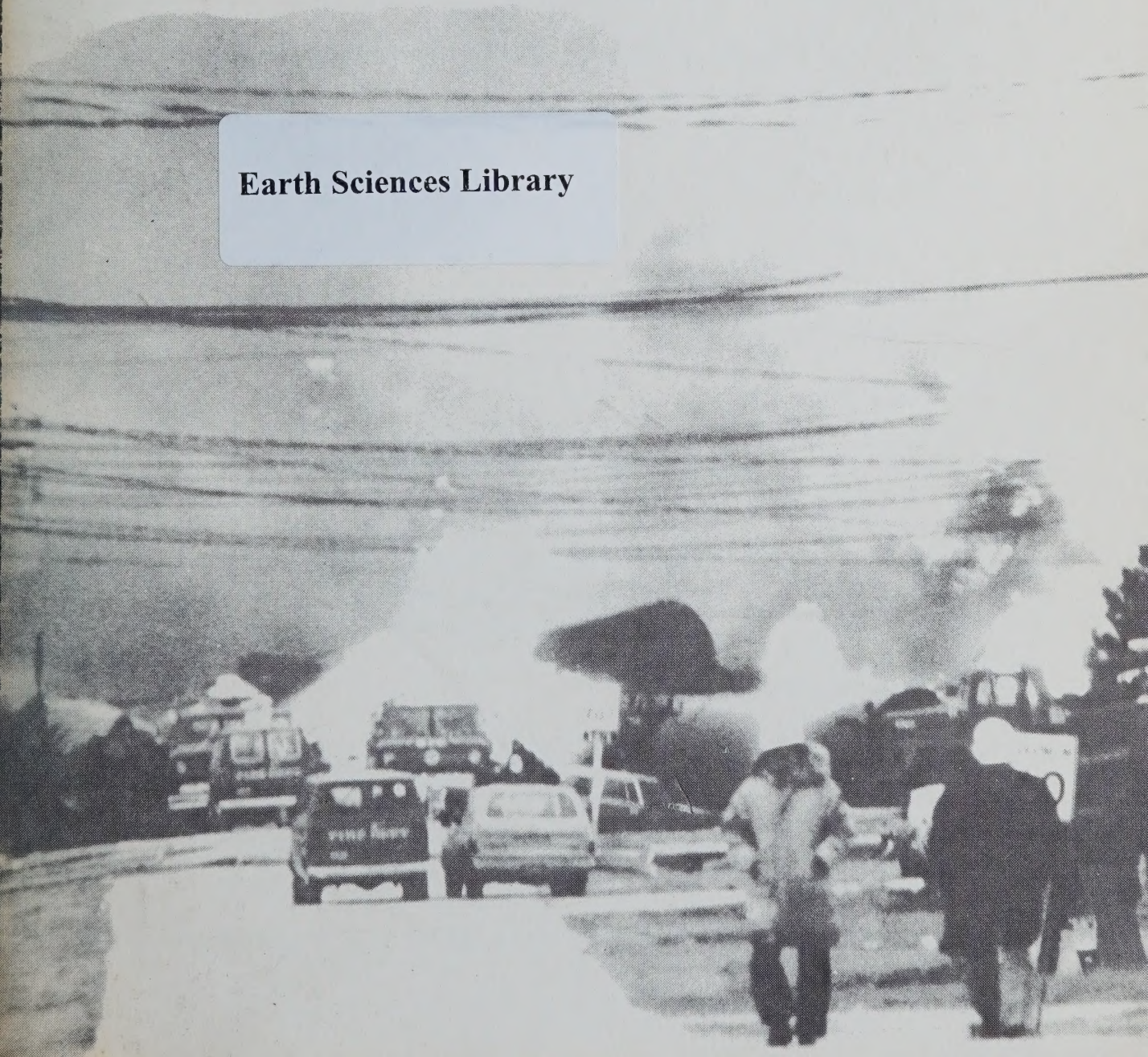
ATMOSPHERIC MONITORING for TRANSPORTATION EMERGENCIES

Volume 1:

**Development of a
priority chemicals list**



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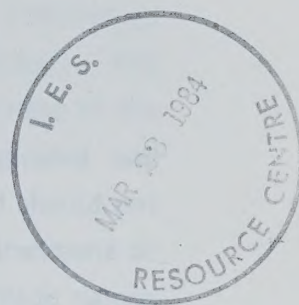


ISBN 0-7743-6780-6

ATMOSPHERIC MONITORING
FOR TRANSPORTATION EMERGENCIES

VOLUME I

DEVELOPMENT OF A PRIORITY CHEMICALS LIST



A Report Prepared for the
Ontario Ministry of the Environment

MOE Report ARB-030-81

By

M.M. Dillon Limited
Consulting Engineers and Planners

&

CONCORD SCIENTIFIC CORPORATION
Environmental & Occupational
Hygiene Consultants

AUGUST, 1981

ISBN 0-7704-2180-8

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1. INTRODUCTION

1.1 Background and Purpose

The Ministry of the Environment is frequently called upon to monitor on-site concentrations of chemicals which have been released to the atmosphere by spills, fires and similar contingencies involving toxic or other hazardous substances. Whether the requirement is for "real-time" monitoring or prompt analysis of collected samples, considerable research and development must be carried out to prepare reliable monitoring instrumentation or sampling and analytical techniques. The cost of developing methodology and maintaining preparedness for all possible chemical contingencies would be enormous.

The Ministry has therefore devised a program, first to compile a list of priority chemicals most likely to be involved in transportation-related emergencies; and second, to develop an information handbook to assist field crews in the atmospheric monitoring of these chemicals.

In June 1980, M.M. Dillon Limited, in association with Concord Scientific Corporation, was retained by the Ministry to carry out a study to implement both parts of this program. This report forms Volume 1 of a three volume set prepared during the course of the study:

Volume 1	Development of a Priority Chemicals List
Volume 2	Toxic Substance Monitoring and Safety Handbook
Volume 3	Detailed Monitoring Methods

1.2 Scope of Work

The principal objective for the first part of the study documented in this report (Volume 1), was to develop a priority chemicals list in the order of 50 to 100 chemicals. This list has been compiled by identifying those chemicals posing the highest risk to human health and the environment from transportation-related spills in Ontario.

A screening process was devised by considering the two components of risk posed by chemical transportation: the inherent toxicity of the chemical or its products, and the probability of its being involved in a spill in Ontario.

The toxicity component required the development of a detailed methodology, using the various types of toxicological data available, to uniformly assess the hazards posed by a large number of chemicals. To assist in this endeavour, the services of a physician, Dr. Brian Gibson, were retained. In parallel with the toxicity consideration, extensive data on chemical movements in Ontario were assembled to provide an indication of spill probability. The data were collected primarily from published sources, supplemented by information from government agencies.

In addition to compiling the priority list, a profile of the main manufacturers, distributors and users has been developed for each of the priority chemicals, to provide an indication of regional transportation patterns.

2. APPROACH

2.1 General

The overall approach to the study was to develop a list of chemicals being transported in Ontario and then to apply a screening process to the list. Application of the screening process to the initial chemicals list resulted in a list of chemical commodities, of which some had toxic products. The toxicities of the products were considered along with those of the chemical commodities themselves in developing the list.

In practice, a multi-stage screening process was required as shown in Figure 1. This screening process was based on two types of criteria: those relating to the probability of a spill; and those based on the acute toxicity of the chemical and its reaction or combustion products.

The criteria have been established around certain basic premises and assumptions. These premises and assumptions are summarized below with the rationale for their development.

- a) The probability of a spill can be represented by the total quantity of a chemical being transported in the Province (or stored in association with transportation). This simple approach is dictated by the lack of more detailed data.
- b) Different modes of transport will not be significant in affecting the probability of a spill. The data available are insufficiently detailed to determine by what mode the transportation of individual commodities is carried out. Also, it is then debateable as to whether one mode can be considered more prone to spill than another, either in a general sense or for particular commodities.

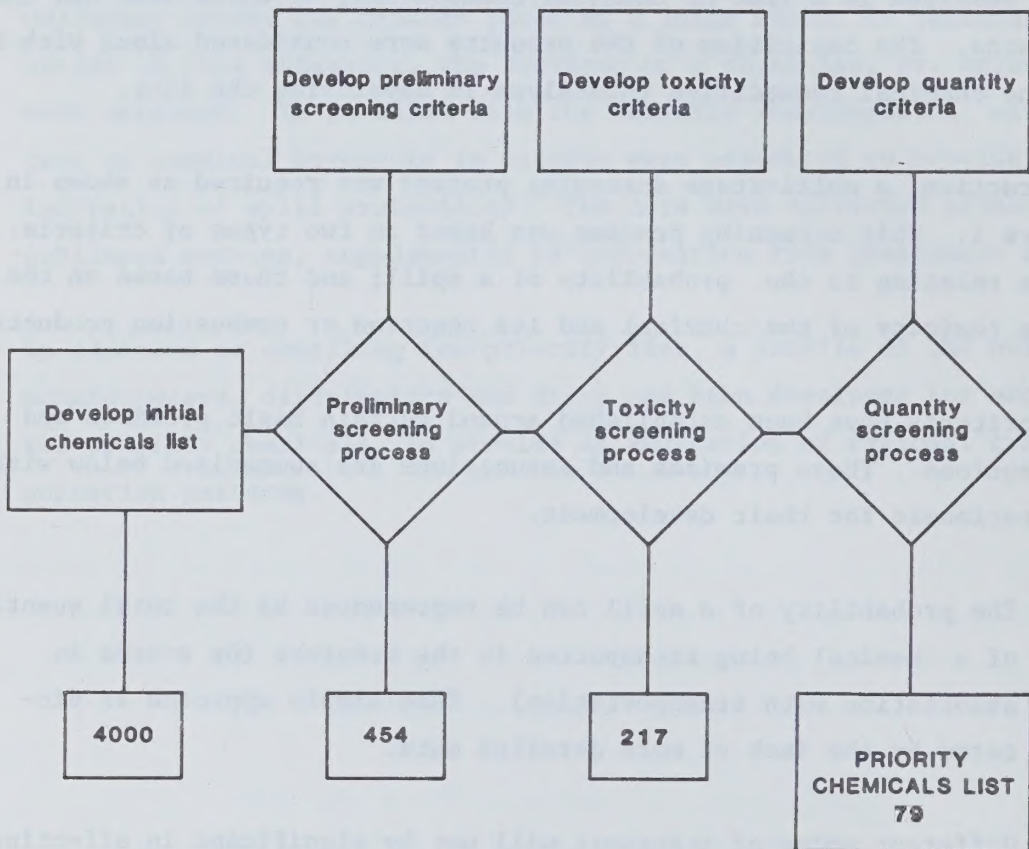


Figure 1
Study Approach

- c) No distinction is made between the type of container used, say drums or bulk, because of lack of data. (In practice, the quantity criteria established generally imply bulk transport.)
- d) The prime hazard posed by a chemical spill is to human health rather than an environmental concern. In view of this consideration and the relatively small number of chemicals required for the priority list, toxicity screening criteria should be restricted to human health.
- e) Toxicity criteria should address health effects produced only through the inhalation or skin absorption routes, since the study is concerned with atmospheric monitoring.
- f) Toxicity criteria should address acute exposure only, which, applied to materials inhaled or absorbed through the skin, refers to a single exposure of a duration measured in seconds, minutes or hours. This is consistent with the situations most commonly encountered in transportation spills.
- g) Toxicity criteria must address not only the hazards presented by individual chemical commodities, but also by their combustion and reaction products.
- h) Toxic combustion products will only be considered for "dangerously flammable" chemicals to reflect the probability of their being produced at a spill incident. "Dangerously flammable" is defined in accordance with the National Fire Protection Association system¹ as having a flash point $\leq 100^{\circ}\text{F}$.
- i) Toxic reaction products will only be considered for reactions with air, water or common construction materials to reflect the types of materials which would likely be contacted at a spill site.

2.2 Development of the Initial Chemicals List

An initial list of approximately 2,500 chemicals that are potentially being transported in Ontario was taken from an earlier report² prepared for Environment Canada. The list in that report was based upon all chemicals listed in the 1972 Canadian Chemical Register and Statistics Canada publications produced in the period 1970-73.

This list was expanded by addition of chemicals from the following sources:

- all chemicals produced in Ontario, as listed in the 1978 Canadian Chemical Register;³
- all chemicals released in spills reported to the Ontario Ministry of the Environment⁴ during the period 1975-80;
- all chemicals listed in Schedule 1 of Regulation 15 under the Environmental Protection Act, 1971;
- the organochlorine pesticides and phenoxy herbicides listed in the 1978 Survey of Pesticide Use in Ontario;⁵
- imported chemicals listed as greater than 20 tonnes per year by Statistics Canada;⁶
- chemicals exported to the U.S. and listed as greater than 20 tonnes per year by the U.S. Department of Commerce;⁷
- chemicals listed in the Environmental Protection Service Hazardous Material Manual;⁸
- chemicals listed in Ministry of the Environment, Air Resources Branch guidelines.⁹

The resulting list was considered to conservatively represent the chemicals which are potentially being transported in the Province. As a further precaution, however, to allow for any chemicals not listed in the above which might be imported from the United States, reference was also made to a U.S. Environmental Protection Agency spill monitoring handbook.¹⁰ The hazardous materials addressed in this handbook include:

- all chemicals designated as "hazardous" by the U.S. Environmental Protection Agency;
- all chemicals in the U.S. Coast Guard's "CHRIS" Manual, 1974;
- those materials reported as spilled in the U.S. during the period 1970-74.

Any additional chemicals listed in the Environmental Protection Agency handbook were added to the list.

2.3 Preliminary Screening

Having produced an initial list of some 4,000 chemicals, the next step in the study was to develop a method of reducing the list of chemicals to a more manageable number. Since the intent of the study is to generate a priority list of chemicals producing effects via airborne transport or impingement mechanisms, the approach adopted was to eliminate those chemicals which do not pose any hazard by this route. Similarly, since it is intended that the emphasis should be on human health effects, rather than discomfort or danger to materials, the following types of chemicals were eliminated:

- chemicals having no known acute toxicity or low acute toxicity via the inhalation or skin absorption routes;

- chemicals whose combustion products have no known acute toxicity or low acute toxicity via the inhalation or skin absorption routes;
- chemicals whose reaction products with air, water or other commonly occurring substances have no known acute toxicity or low acute toxicity via the inhalation or skin absorption routes;
- chemicals whose hazard potential is related solely to fire, explosion or other forms of reactivity which do not generate acutely toxic products. (Although these chemicals may pose acute hazards to human life, the primary concern of this report is atmospheric monitoring.)

The sources of information and procedures used in assessing which chemicals could be eliminated are described in the following:

- a) Acute toxicity ratings were based initially upon the following classification provided by Sax¹¹ (see Appendix 1):

- Unknown
- No toxicity
- Slight toxicity
- Moderate toxicity
- High toxicity

Also listed in some instances, are chemical incompatibilities and the potential for generation of toxic combustion products. Chemicals listed as moderately or highly toxic by inhalation or skin absorption, or producing reaction or combustion products in these categories were retained in the list.

Chemicals clearly not meeting these criteria were rejected. In the case of those chemicals not listed in Sax or those instances where the classification of the chemical was ambiguous, further references were used as follows.

- b) The U.S. Environmental Protection Agency's spill monitoring handbook¹⁰ describes the hazards associated with each listed chemical and provides hazard ratings using the National Fire Protection Association (NFPA) Hazard Identification System. The system uses headings of health, flammability and reactivity rated by a score of 0 to 4.

In general, materials with a health rating of 1 or less and a reactivity rating of 0 were eliminated. In instances where any conflict arose between the NFPA rating and the degree of hazard listed in the handbook, the chemical was not eliminated.

- c) In the absence of a listing or clear classification in sources a) and b), reference was made to the Chemical Dictionary¹² for any airborne toxicity hazard. The chemical was retained when the toxicity of the material or its reaction or combustion products was identified as moderate or greater.
- d) As a check on any ambiguities with respect to combustion product toxicity, in some cases it was necessary to refer to the NFPA handbook.¹
- e) As a final check for those chemicals not listed in the above, reference was made to Transport Canada's Emergency Response Guide.¹³

In carrying out the screening process, some intuitive judgement was required in including or eliminating certain chemicals. For instance, materials likely used in very limited quantities, e.g. certain pharmaceutical or precious metal compounds, were eliminated on common sense grounds.

Similarly, for chemicals where no listing under any of the above references was identified, these were eliminated on the basis that although it is possible that their potential for toxic effects may be appreciable,

their absence from any listing suggests that they are sufficiently obscure and limited in quantity to be eliminated. Since the priority list is relatively short and the screening process is relatively coarse at this stage, this approach was considered valid.

On the other hand, when there was any unresolved ambiguity as to a chemical's toxicity and intuitively it was judged to be distributed in large quantities, then the chemical was included at this stage of screening.

On completion of this initial screening process, a list of 454 chemicals was produced as listed in Appendix 2.

2.4 Toxicity and Quantity Screening

In proceeding from the intermediate list of 454 chemicals to the required 50 to 100, it was recognized, as a fundamental part of the screening process, that toxicity and quantity could not be considered in isolation. For example, while it is clear that very highly toxic chemicals will pose a significant risk in all but the smallest quantities, moderately toxic chemicals may or may not be important, depending on the quantities transported. The same considerations of quantity will also determine the significance of relatively low toxicity materials.

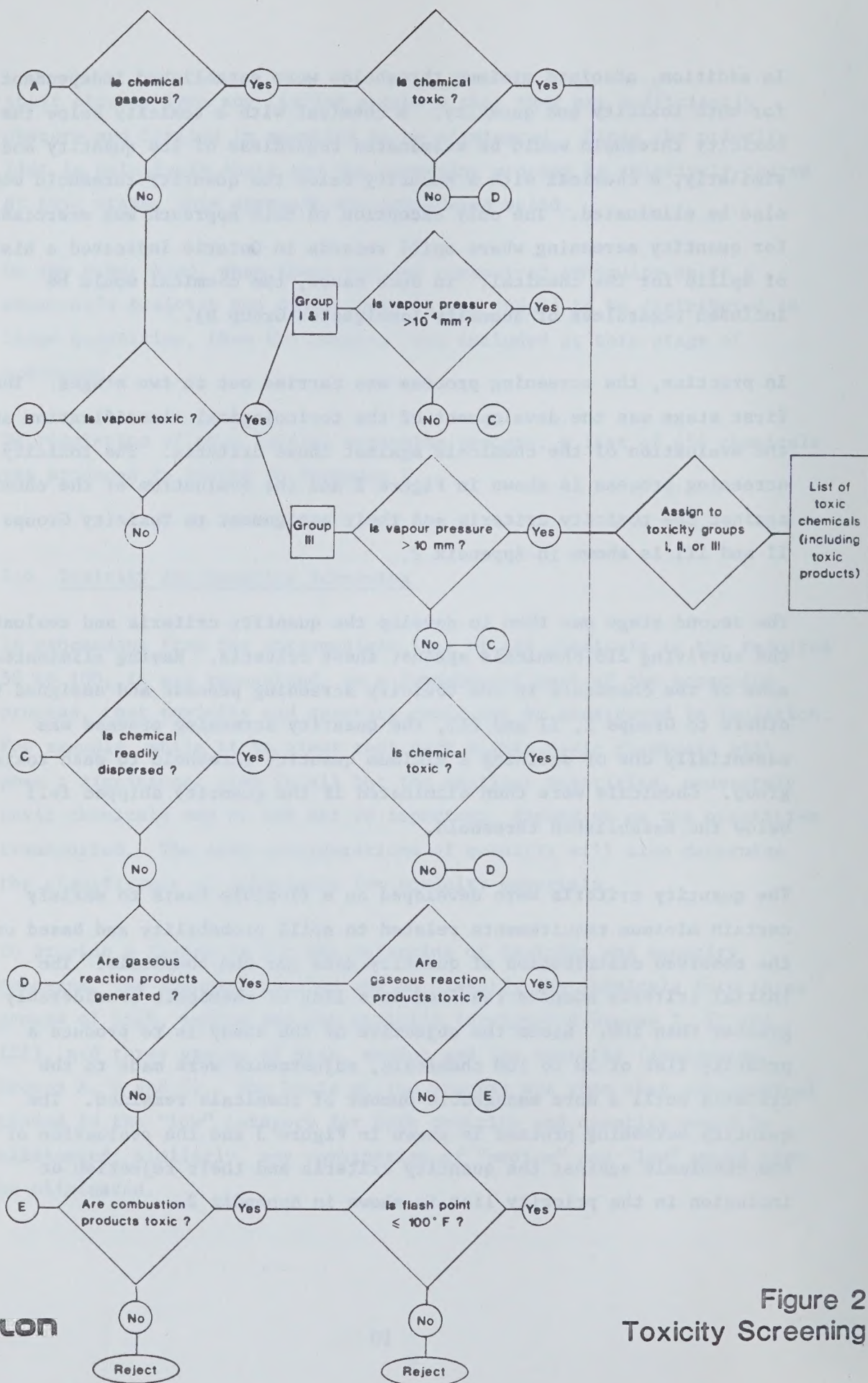
To provide a framework for the balancing of toxicity and quantity concerns, the approach adopted was to classify the chemicals into three groups of high, medium and low toxicity (designated Groups I, II and III), and three groups of high, medium and low quantity (designated Groups A, B and C). The basis of the process was then that any chemical placed in the "low" category for both toxicity and quantity would be eliminated; similarly, any combination of "medium" and "low" would also be eliminated.

In addition, absolute minimum thresholds were established independently for both toxicity and quantity. A chemical with a toxicity below the toxicity threshold would be eliminated regardless of its quantity and similarly, a chemical with a quantity below the quantity threshold would also be eliminated. The only exception to this approach was exercised for quantity screening where spill records in Ontario indicated a history of spills for the chemical: in such cases, the chemical would be included regardless of quantity (designated Group D).

In practice, the screening process was carried out in two stages. The first stage was the development of the toxicological classification and the evaluation of the chemicals against these criteria. The toxicity screening process is shown in Figure 2 and the evaluation of the chemicals against the toxicity criteria and their assignment to Toxicity Groups I, II and III is shown in Appendix 2.

The second stage was then to develop the quantity criteria and evaluate the surviving 218 chemicals against these criteria. Having eliminated some of the chemicals in the toxicity screening process and assigned the others to Groups I, II and III, the quantity screening process was essentially one of defining a minimum quantity threshold to each toxicity group. Chemicals were then eliminated if the quantity shipped fell below the established threshold.

The quantity criteria were developed on a flexible basis to satisfy certain minimum requirements related to spill probability and based on the observed distribution of quantity data for the chemicals. The initial criteria adopted resulted in a list of chemicals considerably greater than 100. Since the objective of the study is to produce a priority list of 50 to 100 chemicals, adjustments were made to the criteria until a more manageable number of chemicals remained. The quantity screening process is shown in Figure 3 and the evaluation of the chemicals against the quantity criteria and their rejection or inclusion in the priority list is shown in Appendix 2.



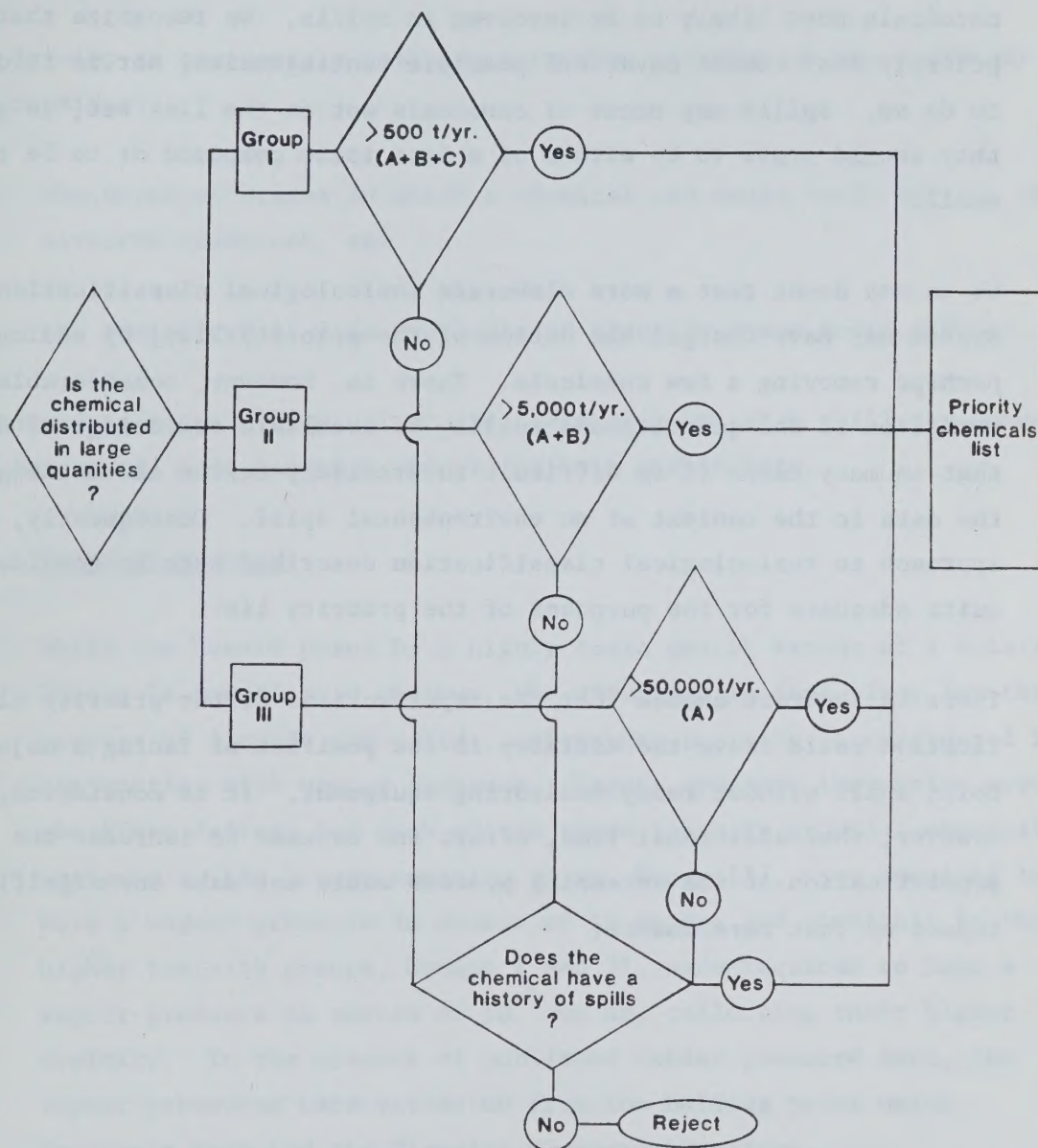


Figure 3
Quantity Screening

It was not considered necessary to define the hazard ratings more elaborately. The purpose of the priority list is to put the Ministry of the Environment in a position of readiness to monitor those highly toxic chemicals most likely to be involved in spills. We recognize that the priority list cannot cover all possible contingencies, nor is it designed to do so. Spills may occur of chemicals not on the list but, in general, they should prove to be either of a less toxic compound or to be relatively small.

We do not doubt that a more elaborate toxicological classification system may have changed the bottom of the priority list, by adding or perhaps removing a few chemicals. There is, however, considerable variation in the quantity and quality of available toxicological data so that in many cases it is difficult to precisely define the meaning of the data in the context of an environmental spill. Consequently, the approach to toxicological classification described here is considered quite adequate for the purposes of the priority list.

There is the rare chance that the imperfections of the priority classification could leave the Ministry in the position of facing a major toxic spill without ready monitoring equipment. It is considered, however, that additional time, effort and expense to increase the sophistication of the screening process would not make any significant impact on that rare chance.

3. TOXICITY SCREENING PROCESS

3.1 Introduction

To develop an appropriate toxicity screening process, it was necessary to consider:

- the physical states in which a chemical can cause toxic effects via airborne transport, and
- the toxicological data available to classify these toxic effects.

Exposure to a toxic chemical or its toxic products at a spill can occur in two ways: as a gas or a vapour; or as a particulate.

a) Gases or Vapours

While the hazard posed by a highly toxic gas or vapour of a volatile liquid is immediately obvious, the situation is less clear for the vapours of liquids and solids, unless the toxicity is considered in conjunction with vapour pressure. Vapour pressure thresholds were therefore defined for each of the three toxicity groups: chemicals assigned to the lowest toxicity group, Group III, were required to have a vapour pressure in excess of 10 mm Hg; and chemicals in the higher toxicity groups, Groups I and II, were required to have a vapour pressure in excess of 10^{-4} mm Hg, reflecting their higher toxicity. In the absence of published vapour pressure data, the vapour pressures were estimated from the boiling point using Trouton's Rule and the Clausius-Clapeyron Equation.

The primary exposure route for gases and vapours was considered to be by inhalation. Dermal exposure data were also considered as some chemicals can give a high toxic effect because of rapid absorption through the skin. In practice, however, dermal exposure did not lead to any changes in classification.

b) Particulates

Many solid chemicals are shipped as a powder. In a spill the powder could be blown around by the wind or dispersed by fire or explosion, giving a significant exposure hazard. The dynamics and probabilities related to this hazard will be different from those of gases and vapours, but were still considered to be significant for the purposes of this study. Chemicals shipped as powders, or as solids with a dust hazard identified in the literature, were therefore assessed on the basis of their toxicity, irrespective of vapour pressure.

Exposure to liquids can occur as a mist, but this is a less likely occurrence in the spill situation. It was, therefore, generally not considered to be a significant hazard for non-volatile liquids.

The toxicity criteria for both gases or vapours, and particulates must be sufficiently comprehensive to take account of the different types of toxicological data available and must be inter-related in defining toxicity groups. A review of classification systems adopted for similar purposes was undertaken,^{1, 18-21} including those used both by the U.S.¹⁴ and Canadian¹⁵ Departments of Transportation. All of the systems reviewed, however, were found to be unsuitable, being generally too limited in scope to apply to a large group of chemicals with different types of data available.

Consequently, a classification system was evolved using toxicity criteria specifically developed to meet the requirements of the study and to have application to the different types of toxicological data available.

For gases and vapours, toxicological data for the inhalation mode are expressed as a concentration in air. Toxicity data for particulates are sometimes given in terms of a concentration by weight of the dust in a volume of air (because such exposures occur on a routine basis in the industrial environment) but are usually given in terms of an absorbed dose, i.e. a certain amount of the chemical taken into a test animal per

unit of body weight by a specific route. Such data is only roughly comparable with toxicity data expressed as a concentration in air, but it must be remembered that the dynamics of the two exposures in a spill situation will also be different.

In general, where toxicity evaluations were available as a vapour concentration in air, these were preferred. The principal exception to this was in the case of powders with no significant vapour pressure ($< 10^{-4}$ mm Hg) where the exposure would be to the dispersed dust rather than a vapour. In these cases, the concentration by weight of dust in a volume of air was the basis for the toxicity criteria, with no consideration of vapour pressure.

A complication was encountered for those liquids where the actual exposure at a spill would be as a vapour, but the only toxicity data available rated them according to an absorbed dose per body weight. These toxicity evaluations are derived by animal experimentation. They are generally chemicals which are not commonly found in the industrial workplace. These chemicals were given a toxicity rating as if their exposure were by particulate absorption (since this was the only data available). In practice, they tended to be of relatively low toxicity so that they were either eliminated or fell into Toxicity Group III. The toxicity thresholds for the particulate absorption data were set conservatively to give some assurance that toxic liquids would not be overlooked because of the imperfection in data availability.

3.2 Toxicity Criteria from Inhalation Data

Four types of toxicological data are available to rate the toxicity of chemicals in terms of air concentrations:

- IDLH: level of exposure immediately dangerous to life or health; usually defined as a thirty minutes exposure and used as a guide in the industrial situation as a level at which workers would not be able to safely escape from exposure to a chemical if their respiratory protective equipment failed. Values for many chemicals are given by NIOSH.²²
- TLV: threshold limit value, a level of exposure judged safe by a regulatory agency or expert committee for chronic exposure in the workplace. The major listing from the United States is that of the American Conference of Governmental Industrial Hygienists.²³
- LC_{LO}: lowest published lethal concentration. This is a value almost always determined from animal experiments that represents the threshold concentration for the first animal to die from exposure for a set period of time (usually one-half to four hours). Below this air concentration no animal of the species used in the experiment will die from the exposure, but once above it some animals will begin to die.
- LC₅₀: lethal concentration, 50%. Similar to the LC_{LO}, but this is the concentration at which 50 per cent of the experimental animals died. A variety of sources^{11, 24-26} publish the results of such toxicological experiments for both LC_{LO} and LC₅₀ values.

The data was used in the preference order:

$$IDLH > TLV > LC_{LO} > LC_{50}$$

and the chemicals assigned to the toxicity groups shown in Table 1.

TABLE 1
TOXICITY CRITERIA
FROM INHALATION DATA

GROUP	IDLH (ppm)	TLV (ppm)	LC _{LO} (ppm)	LC ₅₀ (ppm)
I	≤ 50	≤ 10	≤ 50	≤ 500
II	> 50 ≤ 1,000	>10 ≤ 100	> 50 ≤ 1,000	>500 ≤ 10,000
III	> 1,000 ≤ 10,000		>1,000 ≤ 10,000	>10,000 ≤ 50,000
Reject	> 10,000	> 100	> 10,000	> 50,000

For liquids where the data were expressed in milligrams per cubic metre, the values were converted to parts per million.

For solids where the data was expressed in milligrams per cubic metre, the data was converted to moles per litre and a toxicity classification system was set up in moles per litre as shown in Table 2.

TABLE 2
TOXICITY CRITERIA
FROM INHALATION DATA

GROUP	IDLH (moles/litre)	TLV (moles/litre)
I	≤ 2.2 x 10 ⁻⁶	≤ 4.5 x 10 ⁻⁷
II	> 2.2 x 10 ⁻⁶ ≤ 5 x 10 ⁻⁵	>4.5 x 10 ⁻⁷ ≤ 4.5 x 10 ⁻⁶
III	> 5 x 10 ⁻⁵ ≤ 5 x 10 ⁻⁴	
Reject	> 5 x 10 ⁻⁴	> 4.5 x 10 ⁻⁶

The criteria provide a conservative assessment of the relative hazards considering the likelihood of dangerous concentrations being achieved in open spaces.

The IDLH was chosen as the preferred parameter where it was available. It represents an expert opinion and is based on all the available toxicological data on the hazard to human health from acute exposure to the chemical. This type of exposure most closely resembles the situation arising at a spill.

The TLV was taken as the second number of choice if an IDLH was not available. It is based on expert evaluation of the available toxicological data of the hazard of the chemical to human health. Its major drawback is that it addresses chronic as well as acute exposure. This was considered to be a lesser drawback than the uncertainties of a number based on a single set of experimental conditions in a single animal extrapolated to man, as in LC_{10} s or LC_{50} s.

Chronic effects would tend to give a chemical a higher toxicity rating than the acute effects in some situations (carcinogenicity of the chemical as an example). The reverse should not occur. Using TLVs to rate the chemicals would therefore tend to give some chemicals a higher rating than justified by their acute hazard. This, however, is a conservative approach and was specifically used unless it was known that:

- a low TLV was definitely based on the chronic exposure, and
- other data clearly indicated that the toxicity rating for the purposes of the priority list should be less hazardous.

It was not considered that the range in TLV values safely allowed breaking the chemicals into three groups because of their definition as chronic exposure levels. There would be considerable variation among chemicals in the ratio of their acute to chronic toxicities. Consequently, the study established only two groups, which were defined as comparable to Groups I and II.

It was considered that chemicals representing no hazard in the workplace for continual exposure at a concentration of 100 ppm would be very unlikely to reach dangerous concentrations in the spill situation. Chemicals having a TLV greater than 100 ppm were therefore rejected.

The third choice, LC_{LO} data are experimental results in animals. It can be argued that the acute toxicity of an airborne concentration in a more rapidly metabolizing small species would be greater than a larger species such as man. Interspecies variation also can be considerable. These animal experiments, however, usually represent a longer exposure period than the 30 minutes exposure time used for the IDLH. They therefore tend to underestimate the lethal threshold for 30 minute exposure. This suggests that animal LC_{LO} s are a conservative estimate of the human IDLH, although there is a wide margin of uncertainty. For the purposes of classification the LC_{LO} values were therefore equated to the IDLHs, with the proviso that the LC_{LO} from the animal species giving the highest estimate of toxicity would be used.

The final type of data, the LC_{50} s have similar limitations to those identified for LC_{LO} s. It is desirable to be able to convert LC_{50} s to LC_{LO} s for application to human health in a spill situation. It is possible to do this by examining the dose-response curve for the chemical under study. Although the slope of the curve varies, an LC_{LO} as 1/10 of the LC_{50} was considered a conservatively safe estimate for the majority of chemicals. The LC_{50} thresholds for the various toxicity groups were therefore set at ten times the LC_{LO} threshold values.

3.3 Toxicity Criteria from Particulate Absorption Data

When exposure does not occur as inhalation of a gas or vapour, or data is not available for this mode, the toxicological information is generally expressed as an amount absorbed into the body. The data will specify the species in question, the route of absorption and the time frame of

exposure in order to produce a certain result within a specific time frame. For example, the ingestion of a certain number of milligrams per kilogram of a chemical taken as a single dose in food caused fifty per cent of rats to die within 48 hours.

The major problem in trying to set up a classification system for a series of chemicals based on this data is the vast array of experimental conditions that have been used. A value from one experiment is not necessarily comparable to a value from another experiment on a different chemical, unless all the parameters (other than the difference of chemicals) in the two experiments were the same. To fully compare one chemical to another chemical on the basis of such data would involve an extensive toxicological review of all the data available for those chemicals.

For the purpose of the priority list, it was considered that it would be simpler to define the three groups very conservatively so that any errors would tend to rate the hazard of individual chemicals too high rather than too low. The majority of chemicals that are rated in this way represent less common chemicals that have not received a toxicological review to establish airborne concentration hazards. Most of these relatively obscure chemicals with the potential to be over-rated were later rejected because of the low quantities being shipped in Ontario.

The toxicity criteria, which were established to define the toxicity groups using particulate absorption data, are shown in Table 3.

TABLE 3
TOXICITY DATA FROM PARTICULATE
ABSORPTION DATA

GROUP	LD _{L0} (mg/kg)	LD ₅₀ (mg/kg)
I	≤ 0.1	≤ 1
II	> 0.1 ≤ 5	> 1 ≤ 50
III	> 5 ≤ 50	> 50 ≤ 500
Reject	> 50	> 500

These thresholds are comparable to those used for defining the high, medium and low toxicity groups developed from inhalation data. Several points however, should be noted as to how these data were applied.

- The data exists for the most part as LD_{L0}, lowest published lethal dose, and LD₅₀ lethal dose, 50 per cent, experimental results. Similarly to the LC_{L0} and LC₅₀ situation, the cut-offs for LD₅₀s were set at ten times the cut-offs for LD_{L0}s.
- Some human data exists because of human exposure through accidental or suicidal situations. This was used if available. Otherwise the animal results giving the highest estimate of toxicity were used.
- The specific gravity and molecular weight varies considerably among chemicals. Compounds that are equally toxic, molecule for molecule, will be rated differently by toxicity data expressed in milligrams per kilogram, if their specific gravities are different. Thus, a more hazardous compound might be given a lower toxicity class using this system. However, the compounds of higher molecular weight will tend to be more dense and thus less likely to be dispersed by the wind in an environmental spill situation. These two considerations will probably cancel each other out.

- The route of administration most commonly used for these experiments is the oral route. However, at times it can be difficult to get animals to consume certain chemicals in their food. The chemical may, therefore, be administered directly into the peritoneal cavity, under the skin, intravenously or intramuscularly, or applied to the skin. The response to these different methods of exposure will vary for a given animal species. It was considered, however, that this broad margin of uncertainty would be compensated for by the selection of conservative thresholds. The thresholds were therefore selected to allow treatment of data on oral, intra-peritoneal or subcutaneous systemic absorption as comparable.

3.4 Results of Toxicity Screening Process

After the toxicity screening process, 217 chemicals remained. The list of chemicals with their toxicity groups is shown in Table 4. This list of toxic chemicals provides the starting point for the quantity screening process.

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING

<u>Toxicity Group</u>	<u>Chemical</u>
III	Acetaldehyde
II	Acetic acid
II	Acetic anhydride
I	Acetonitrile
I	Acetyl chloride
I	Acrolein
I	Acrylamide
I	Acrylonitrile
I	Aldicarb
II	Allyl alcohol
I	Aluminum alkyl compounds
II	Aluminum chloride
III	2-Aminothiazole
II	Ammonia (anhydrous)
II	Ammonium hydroxide
I	Ammonium silicofluoride
II	Ammonium sulphide
II	n-Amyl alcohol
I	Amyl chloride
II	Aniline
II	Arsenic acid
I	Arsenic trichloride
I	Arsenic trioxide
I	Azinphos-methyl (guthion)
II	Benzene
II	Benzoyl chloride
II	Benzoyl peroxide
I	Benzyl acetate

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING
(continued)

<u>Toxicity Group</u>	<u>Chemical</u>
II	Benzyl alcohol
I	Benzyl chloride
I	Boron tribromide
II	Boron trichloride
II	Boron trifluoride
I	Bromine
III	Bromotrifluoromethane
I	n-Butyl acrylate
III	n-Butyl alcohol
II	t-Butyl hydroperoxide
III	Butyllithium
II	Calcium cyanide
II	Calcium oxide
I	Caprolactam
I	Carbaryl (sevin)
II	Carbon disulphide
III	Carbon monoxide
II	Carbon tetrachloride
I	Carbonyl chloride (phosgene)
I	Chlorine
I	Chlorine dioxide
I	Chlorobenzene
I	Chlorobutane
II	Chloroform
I	Chlorosulphonic acid
II	Copper cyanide
II	Cresols

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING
(continued)

<u>Toxicity Group</u>	<u>Chemical</u>
I	Cumene hydroperoxide
III	Cyanogen iodide
I	Cyanopyridine
III	Cyclohexane
I	Cyclohexylamine
II	2,4-D (dichlorophenoxyacetic acid)
I	Decaborane
III	1,2-Diaminocyclohexane
I	Diazinon
I	Diborane
II	1,4-Dichlorobenzene
III	Dichloromethane
II	1,3-Dichloropropene
II	2,2-Dichloropropene
III	Diethyl amine
II	Diethyl sulphate
II	Diisobutylene
II	Dimethoate
III	Dimethylamine
II	Dimethyl ether
I	Dimethyl sulphate
II	Dimethyl sulphide
I	2,4-Dinitrotoluene
II	1,4-Dioxane
I	Diphenyl
I	Diphenylamine
I	Diphenyl methane 4,4-diisocyanate

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING
(continued)

<u>Toxicity Group</u>	<u>Chemical</u>
II	Diquat
I	Divinylbenzene
I	Epichlorohydrin
III	Ethyl acetate
III	Ethyl acrylate
III	Ethylbenzene
II	Ethyl chloride
III	Ethylene diamine
II	Ethylene dibromide
I	Ethylene dichloride
II	Ethylene glycol dinitrate
III	Ethylene glycol monoethyl ether acetate
II	Ethylene glycol monomethyl ethers
I	Ethyleneimine
II	Ethylene oxide
II	Ethyl mercaptan
II	Ferric sulphide
I	Ferrosilicon
II	Ferrous phosphide
II	Fluorine
II	Formaldehyde
II	Formamide
II	Formic acid
II	Furfuryl alcohol

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING
(continued)

<u>Toxicity Group</u>	<u>Chemical</u>
I	Heptachlor
III	Heptane
II	Hexamethylenediamine
I	Hexamethyleneimine
II	Hydrazine
II	Hydrochloric acid
I	Hydrofluoric acid
II	Hydrogen chloride (anhydrous)
I	Hydrogen fluoride
II	Hydrogen peroxide
II	Hydrogen sulphide
I	Iodine
III	Isoamyl alcohol
III	Isobutanol
III	Isobutyl methyl ketone
II	Isophorone
III	Isopropyl ether
I	Maleic anhydride
I	Mercuric nitrate
I	Mercury
II	Methacrylic acid
III	Methyl acetate
II	Methyl acrylate
I	Methylamine
I	Methyl bromide
I	Methyl chloride

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING
(continued)

<u>Toxicity Group</u>	<u>Chemical</u>
III	Methylene dianiline
I	Methylene iodide
III	Methyl ethyl ketone
I	Methyl ethyl ketone peroxide
II	Methyl iodide
II	Methyl mercaptan
I	Molybdenum trioxide
I	Monoethanolamine
I	Morpholine
III	Napthax
II	Naphthalene
I	Nickel carbonyl
II	Nitric acid
II	Nitrobenzene
I	Nitrogen dioxide
I	Nitrohydrochloric acid
III	Nitrous oxide
II	Octyl phenol
II	Oxalic acid
II	Paraformaldehyde
I	Parathion
I	Pentaborane
I	Pentachloroethane
I	Pentachlorophenol
II	Perchloroethylene

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING
(continued)

<u>Toxicity Group</u>	<u>Chemical</u>
I	o-Phenetidines
II	Phenol
I	Phenylmercuric oleate
I	Phosphoric acid
I	Phosphorus
II	Phosphorus pentachloride
II	Phosphorus pentasulphide
I	Phosphorus pentoxide
II	Phosphorus sesquisulphide
I	Phosphorus trichloride
II	Polychlorinated biphenyls (PCB)
II	Potassium copper cyanide
I	Potassium cyanide
II	1-Propanethiol
III	Propionaldehyde
III	n-Propyl alcohol
III	Propylene dichloride
II	Propylene oxide
I	Pyridine
II	Silicon tetrachloride
I	Silver cyanide
I	Sodium arsenite
II	Sodium chloroplatinate
II	Sodium copper cyanide
I	Sodium cyanide
III	Sodium sulphite
II	Stannous fluoride

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING
(continued)

<u>Toxicity Group</u>	<u>Chemical</u>
III	Styrene
II	Sulphur dioxide
II	Sulphuric acid
I	Sulphur monochloride
I	Sulphur trioxide
II	Sulphurous acid
II	Tetrachloroethane
I	Tetraethyl lead
II	Tetrahydronaphthalene
I	Tetramethyl lead
III	Thioglycolic acid
I	Titanium tetrachloride
III	Toluene
I	Toluene 2,4-diisocyanate
II	o-Toluidine
I	Toxaphene
III	Tri-butyl phosphate
I	1,2,4-Trichlorobenzene
II	1,1,1-Trichloroethane
II	Trichloroethylene
I	Trichloroisocyanuric acid
III	2,4,5-Trichloromonofluoromethane
III	Trichlorotrifluoroethane
II	Tricresyl phosphates
II	Triethylamine
II	1,2,4-Trimethylbenzene
II	2,2,4-Trimethylpentane (isooctane)

TABLE 4
LIST OF CHEMICALS AFTER
TOXICITY SCREENING
(continued)

<u>Toxicity Group</u>	<u>Chemical</u>
I	Vanadium pentoxide
I	Vinyl acetate
I	Vinyl chloride
I	Vinylidene chloride
III	Xylene
II	o-Xylenol

4. QUANTITY SCREENING PROCESS

4.1 Introduction

To develop the final list of priority chemicals, two types of criteria were used, relating to the quantity of chemicals shipped and to previous spill records. Of the two types of criteria, the quantity data were more significant, as reliable records of spills are comparatively recent and limited in number.

Ideally, the quantity data required for assessing spill probability are the total quantities of chemicals transported (and stored in association with transportation) in the Province. In practice, specific data on total amounts shipped are generally not available, and it is necessary to use data of the following types:

- quantity shipped (by Canadian manufacturers)
- quantity produced
- quantity used
- quantity exported
- quantity imported
- quantity sold

There are two principal limitations involved in using this type of data:

- The statistics are often presented as groupings of commodities, for which it is difficult to determine a breakdown for individual commodities. Statistics were only used for specific commodities rather than groupings, unless the groupings were very small or could be related to toxicity data for a similar grouping, e.g. aluminum alkyl compounds.
- The statistics are generally prepared for Canada as a whole without a breakdown by province that would provide data specific to Ontario. In the absence of a workable alternative, this data was commonly used, and was considered a conservative approach in that it would tend to overestimate rather than underestimate quantities.

Since different types of statistics are available for different commodities, a method of using these different types was required to produce a uniformly applicable rating system. We can consider the required shipment information to be made up of the various available types of data in the following way:

Total quantity transported (T) = Imports(I) + Domestic shipment(S) + Exports
(or stored as part of transportation system)

= Imports(I) + Production(P)/Sales(S)

= Use(U) + Exports(E)

The most commonly available data were for imports and for what can be collectively considered as commodities of domestic origin, i.e. domestic shipments, production or sales. The data are, therefore, presented (in Appendix 3) under the headings of "domestic origin" or "imports", and aggregated to produce a total quantity transported. To avoid any double counting where more than one type of "domestic origin" statistic was available, the largest value was selected.

In addition, some published data was found for commodity use, which could be both domestically produced and imported. For the purposes of presenting the use statistics, they were listed under the heading of "domestic origin" in Appendix 3. However, in calculating the total quantity transported, they were aggregated only with export data.

In instances where both use, and import and/or domestic shipment statistics were available, the higher value was used in calculating the total quantity. These totals are presented in Appendix 3 for each chemical where data was available.

The principal sources of data were Statistics Canada Publications^{6,27-44} and U.S. Import Statistics⁷ published by the U.S. Department of Commerce. Additional specific sources were identified for particular commodities.^{45,46}

4.2 Quantity Criteria

Having assembled the quantity data available for each chemical, a minimum quantity threshold was defined for each toxicity group.

Initially, a minimum threshold of 20 tonnes per year was selected. A quantity of 20 tonnes per year was considered to be approximately equal to one truckload or less than one tank car load per year. On a purely subjective basis this was considered to present a very low probability of a spill incident.

An analysis of the quantity distribution of the remaining chemicals was then carried out as shown in Table 5.

TABLE 5
QUANTITY DISTRIBUTION

<u>Tonnes/year</u>	<u>No. of Chemicals</u>
> 100,000	37
50,000 - 100,000	12
10,000 - 50,000	31
5,000 - 10,000	19
1,000 - 5,000	39
500 - 1,000	18
100 - 500	66
20 - 100	30
< 20	<u>9</u>
TOTAL	261 (out of 454 = 57%)

Based on this distribution the chemicals were divided into three approximately equal groups: Groups A, B and C. The three groups were initially defined as

- Group A > 10,000 t/yr
- Group B > 500 t/yr; $\leq$ 10,000 t/yr
- Group C > 20 t/yr; $\leq$ 500 t/yr

so that the corresponding minimum quantity thresholds for Groups I, II and III were 20 t/yr, 500 t/yr, and 10,000 t/yr. Application of these criteria to the chemicals in Groups I, II and III however, resulted in a chemicals list in excess of 100.

To reduce the number of chemicals, it was therefore necessary to increase the stringency of the quantity criteria. This was considered more appropriate than adjusting the toxicity criteria, which were defined on a less arbitrary basis. After careful examination of the effects of various changes to the quantity criteria, the approach adopted was to increase the quantity thresholds for the toxicity groups, in a way which reflects the quantity distribution shown in Table 5. The adjusted groups were defined as:

Group A	> 50,000 t/yr
Group B	> 5,000 t/yr; $\leq$ 50,000 t/yr
Group C	> 500 t/yr; $\leq$ 5,000 t/yr

An additional Group D was established for chemicals in Toxicity Groups I, II and III which would be eliminated by the quantity thresholds, but for a history of previous spills in Ontario. An analysis of the Ontario Ministry of the Environment, Pollution Control Branch spill records⁴ was carried out for the period 1975-79 and chemicals with greater than one reported spill during that period were included in the priority list.

This arrangement resulted in a list of 64 chemicals, which was less than the optimum number desired by the Air Resources Branch. Options were considered to increase the list by examining the chemicals eliminated, i.e. these classified as II C, III B or III C. Clearly there was no merit in reintroducing chemicals from III C, since these are of lowest concern from both toxicity and quantity considerations. The alternatives were to add either II C or III B to the list. In discussions with staff of the Air Resources Branch, the preferred approach was to emphasize the toxicity concern and include the chemicals classified as II C, adding a further 15 chemicals to the list.

5. PRIORITY CHEMICALS LIST

At the conclusion of the toxicity screening, a list of 79 chemical commodities was generated, of which two were included because of their toxic products.

There were also a further 75 chemicals in Toxicity Groups I, II and III which were not categorized because of the absence of quantity data in the sources searched. A verification was therefore carried out to determine if these chemicals were listed in the Canadian Chemical Register³ as manufactured in Ontario. Thirteen chemicals were identified as Ontario products (plus one captively-used product), of which four were in Toxicity Group I and four in Toxicity Group II. These were considered as potential additions to the priority list; those in Toxicity Group III were excluded, as the likelihood of their exceeding the 50,000 tonne/year threshold was considered negligible.

In addition to chemicals without any quantity data, there were also a number of chemicals eliminated on the basis of import statistics only. A similar check in the Canadian Chemical Register indicated a further 14 chemicals manufactured in Ontario. Of these, four are in Toxicity Group I and six in Toxicity Group II. As before, these were considered potential additions to the list while those in Toxicity Group III were excluded.

Further information on the production levels of these chemicals was sought from the Department of Industry, Trade and Commerce in Ottawa. Based on their response, an additional four chemicals were added to the priority list. The final list of 79 chemical commodities and their toxic products is shown in Table 6. When the commodities are shown in parentheses, this indicates that the concern is with the toxic product only.

To provide an indication of regional transportation patterns for the chemicals on the priority list, a profile of the major manufacturers, distributors and users has been prepared in Appendix 4.

TABLE 6
LIST OF PRIORITY CHEMICALS

<u>Toxicity- Quantity Group</u>	<u>Chemical</u>	<u>Toxic Products</u>
(II B)	Acetic acid	
(II B)	Acetic anhydride	
(I C)	Acetonitrile	Cyanides
(I C)	Acrylamide	
(I B)	Acrylonitrile	Cyanides
(II B)	Aluminum chloride	Hydrogen chloride
(II A)	Ammonia-anhydrous	
(II A)	Ammonium hydroxide	
(II C)	n-Amyl alcohol	
(II C)	Aniline	
(II A)	Benzene	
(I C)	Bromine	
(I B)	n-Butyl acrylate	
(II A)	Calcium oxide	
(I B)	Caprolactam	
(II A)	Carbon disulphide	
(II B)	Carbon tetrachloride	
(I A)	Chlorine	
(II B)	Chloroform	
(I C)	Chlorosulphonic acid	Sulphur oxides
(II C)	Cresols	
(I C)	Cyclohexylamine	
(II C)	1,4-Dichlorobenzene	
(III A)	Dichloromethane	
(II C)	2,4-D	
(II A)	Diisobutylene	
(I C)	Diphenylamine	
(I C)	Diphenyl methane 4,4-diisocyanate	

TABLE 6
LIST OF PRIORITY CHEMICALS
 (continued)

<u>Toxicity- Quantity Group</u>	<u>Chemical</u>	<u>Toxic Products</u>
(I C)	Epichlorohydrin	Carbonyl chloride
(III A)	Ethylbenzene	
(I B)	(Ethyl chloride)	Carbonyl chloride
(II B)	Ethylene dibromide	
(I A)	Ethylene dichloride	Carbonyl chloride, hydrogen chloride
(II A)	Ethylene oxide	
(II A)	Formaldehyde	
(II C)	Formic acid	
(II C)	Furfuryl alcohol	
(II C)	Hexamethylenediamine	
(II A)	Hydrochloric acid	
(I B)	Hydrofluoric acid	
(II A)	Hydrogen chloride (anhydrous)	
(I B)	Hydrogen fluoride	
(II C)	Hydrogen peroxide	
(II D)	Hydrogen sulphide	
(I B)	Maleic anhydride	
(II C)	Methyl acrylate	
(I C)	Methylamine	Nitrogen oxides
(I C)	Methyl chloride	
(I C)	Monoethanolamine	
(I C)	(Morpholine)	Nitrogen oxides
(III A)	Naphtha	
(II C)	Naphthalene	
(II A)	Nitric acid	
(II C)	Oxalic acid	
(II C)	Paraformaldehyde	

TABLE 6
LIST OF PRIORITY CHEMICALS
(continued)

<u>Toxicity- Quantity Group</u>	<u>Chemical</u>	<u>Toxic Products</u>
(I C)	Pentachlorophenol	
(II B)	Perchloroethylene	
(II A)	Phenol	
(I A)	Phosphoric acid	
(I A)	Phosphorus	Phosphorus oxides
(II D)	Polychlorinated biphenyls (PCB)	
(III A)	n-Propyl alcohol	
(III A)	Propylene oxide	
(I B)	Sodium Cyanide	
(III A)	Styrene	
(II A)	Sulphur dioxide	
(I C)	Sulphur monochloride	Hydrogen chloride
(II A)	Sulphuric acid	
(I B)	Tetraethyl lead	
(I C)	Tetramethyl lead	
(I C)	Titanium tetrachloride	Hydrogen chloride
(III A)	Toluene	
(I B)	Toluene 2,4-diisocyanate	
(II B)	1,1,1-Trichloroethane	
(II B)	Trichloroethylene	
(I C)	Vanadium pentoxide	
(I B)	Vinyl acetate	
(I A)	Vinyl chloride	Carbonyl chloride, hydrogen chloride, carbon monoxide
(III A)	Xylene	

APPENDIX 1

1. Definition - A substance is considered to be a hazardous material if it meets any of the following criteria:
2. Physical Hazard - A substance that is explosive, flammable, or highly reactive under normal conditions of transport.
3. Health Hazard - A substance that is toxic, corrosive, or causes other adverse health effects.
4. Environmental Hazard - A substance that is highly toxic, persistent, or bioaccumulative.

APPENDIX 1

TOXICITY CLASSIFICATION AFTER SAX

1. Acute Toxicity - The ability of a substance to cause harm or death to humans or animals after a single exposure or short-term exposure.
2. Chronic Toxicity - The ability of a substance to cause harm or death to humans or animals after repeated or long-term exposure.
3. Sublethal Toxicity - The ability of a substance to cause adverse effects on the reproductive, developmental, or immune systems of humans or animals.
4. Genotoxicity - The ability of a substance to damage or alter the genetic material (DNA) of a cell.
5. Carcinogenicity - The ability of a substance to cause or promote the development of cancer.
6. Reproductive Toxicity - The ability of a substance to cause adverse effects on the reproductive system of humans or animals.
7. Developmental Toxicity - The ability of a substance to cause adverse effects on the development of a fetus or embryo.
8. Immunotoxicity - The ability of a substance to cause adverse effects on the immune system of humans or animals.
9. Neurotoxicity - The ability of a substance to cause adverse effects on the nervous system of humans or animals.
10. Endocrine Disruption - The ability of a substance to interfere with the normal function of the endocrine system.

APPENDIX 1
TOXICITY CLASSIFICATION AFTER SAX¹¹

1. Unknown - Assigned to chemicals for which insufficient toxicity data are available for a valid assessment.
2. No Toxicity - assigned to materials which cause no harm under any conditions of normal use or which produce toxic effects on humans only under the most unusual conditions or overwhelming dosage.
3. Slight Toxicity - assigned to materials which produce changes in the body which are readily reversible and which will disappear following termination of exposure, either with or without medical intervention.
4. Moderate Toxicity - assigned to substances which may produce irreversible, as well as reversible, changes to the human body. These changes are not of such severity as to threaten life or to produce serious permanent physical impairment.
5. High Toxicity - assigned to those substances which can cause physiological damage of such severity as to threaten life or cause permanent physical impairment and/or disfigurement.

APPENDIX 2

Medical Research

1.1	General medicine
1.2	Neurology
1.3	Psychiatry
1.4	Internal medicine
1.5	Cardiology
1.6	Respiratory medicine
1.7	Gastroenterology
1.8	Endocrinology
1.9	Immunology
1.10	Genetics
1.11	Pharmacology
1.12	Physiology
1.13	Pathology
1.14	Microbiology
1.15	Immunology
1.16	Genetics
1.17	Pharmacology
1.18	Physiology
1.19	Pathology
1.20	Microbiology

APPENDIX 2

ASSIGNMENT OF CHEMICALS TO
TOXICITY GROUPS

Table 2

1.1	General medicine
1.2	Neurology
1.3	Psychiatry
1.4	Internal medicine
1.5	Cardiology
1.6	Respiratory medicine
1.7	Gastroenterology
1.8	Endocrinology
1.9	Immunology
1.10	Genetics
1.11	Pharmacology
1.12	Physiology
1.13	Pathology
1.14	Microbiology
1.15	Immunology
1.16	Genetics
1.17	Pharmacology
1.18	Physiology
1.19	Pathology
1.20	Microbiology

GLOSSARY OF ABBREVIATIONS, UNITS AND SYMBOLS

ABBREVIATIONS

Physical Properties

V.P.	vapour pressure
B.P.	boiling point
M.P.	melting point
F.P. (cc)	flash point (closed cup) - open cup data in parentheses
C/P	Crystal/Powder
G	gas
D	decomposes
S	sublimes
L	liquid
G(L)	gas (shipped as liquid)
NF	non-flammable

Toxicity

IDLH	Immediately dangerous to life and health
TLV	Threshold Limit Value
LC ₅₀	Lethal Concentration, 50 per cent
LC _{LO}	Lethal Concentration, lowest published
TC _{LO}	Toxic Concentration, lowest published
IN	Inhalation
OR	Oral
SC	Subcutaneous
IV	Intravenous
IP	Interaperitoneal
RP	Reaction product
CP	Combustion product

GLOSSARY OF ABBREVIATIONS, UNITS AND SYMBOLS
(continued)

Toxicity - continued

R	Rat
RB	Rabbit
GP	Guinea Pig
M	Mouse
H	Human

For toxicity data other than IDLH or TLV, the data have been coded to indicate the mode of exposure and/or whether a reaction or combustion production is involved. Two examples are given below:

RP-HCl-IDLH-100

- RP denotes a reaction product (RP) of a specific compound.
- The product is hydrogen chloride (HCl).
- HCl has an IDLH value of 100 parts per million.
- If 100 were parenthesized (100), the units would be milligrams per cubic metre.

IN-LC₅₀-R-220(4)

- IN denotes the inhalation (IN) mode of exposure for a specific compound.

GLOSSARY OF ABBREVIATIONS, UNITS AND SYMBOLS
(continued)

IN-LC₅₀-R-220(4) - continued

- The test species is the rat (R) and the chemical has a LC₅₀ value, (lethal concentration, 50%), of 220 parts per million.
- Unless specified in parentheses the exposure time is shown; in this case an exposure time of 4 hours is indicated.

Units

Physical Properties

atm	atmospheres
°F	degrees Fahrenheit
°C	degrees Celsius
t	tonnes
mm	millimetres

Toxicity Data

All inhalation toxicity data are presented in parts per million unless in parentheses when the units are milligrams per cubic metre. All data for absorbed doses are presented in milligrams per kilogram.

ppm	parts per million
mg.m ⁻³	milligrams per cubic metre
mg.kg ⁻¹	milligrams per kilogram
mppcf	millions of particles per cubic foot

GLOSSARY OF ABBREVIATIONS, UNITS AND SYMBOLS

(continued)

Chemical Symbols

Al_2O_3	aluminum oxide
As	arsenic
AsH_3	arsine
Be	beryllium
B_2O_3	boron trioxide
Br_2	bromide
CH_3COOH	acetic acid
$\text{C}_6\text{H}_5\text{COOH}$	benzoic acid
$\text{C}_6\text{H}_5\text{OH}$	phenol
$\text{C}_6\text{H}_5\text{NH}_2$	aniline
C_6H_6	benzene
Cl_2	chloride
CN	cyanide
CO	carbon monoxide
CO_2	carbon dioxide
COCl_2	phosgene
COF_2	carbonyl fluoride
F_2	fluorine
Fe	iron
HBr	hydrogen bromide
HCHO	formaldehyde
HCl	hydrogen chloride
HCN	hydrogen cyanide
HF	hydrogen fluoride
Hg	mercury
H_2O	water
H_2O_2	peroxide
H_2S	hydrogen sulphide
H_2Se	hydrogen selenide

GLOSSARY OF ABBREVIATIONS, UNITS AND SYMBOLS
(continued)

Chemical Symbols - continued

H_2SO_4	sulphuric acid
I_2	iodine
N_2	nitrogen
NaOCl	sodium hypochlorite
NaOH	sodium hydroxide
NH_3	ammonia
NO_x	oxides of nitrogen
O_2	oxygen
PH_3	phosphine
PO_x	oxides of phosphorus
P_2O_5	phosphoric acid
Se	selenium
Sn	tin
SO_2	sulphur dioxide
SO_x	oxides of sulphur

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOG X R I O C U P T Y
	STATE	VAPOR PRESSURE		B.P. °C	FLASH POINT °F(CC)	IDLH ppm (mg/m ³)	TLV	OTHER DATA		
		mm	@ °C							
ACETALDEHYDE	L	740	20	21	- 36	10,000	100			III
ACETIC ACID	L	11	20	118	104	1,000	10			II
ACETIC ANHYDRIDE	L	4	20	140	121	1,000	5			II
ACETOACETANILIDE	C	0.01	20	D	325			IP-LD50-M-300		X
ACETONE	L	400	40	57	1	20,000	1,000			X
ACETONITRILE	L	100	27	81	42	4,000	40	CP-HCN-IDLH-50	Decomposes to cyanides in fires	I
ACETYL CHLORIDE	L			51	51			RP-HCl-IDLH-100 CP-COCl ₂ -IDLH-2	Decomp to COCl ₂ , hydro. to HCl, CH ₃ COOH	I
ACROLEIN	L	214	20	53	- 13	5	0.1		Emits toxic vapours of acrolein in fires	I
ACRYLAMIDE	S(L)	0.007	20	125 @ 25 mm	N.F.		(0.3)		Shipped as liquid	I
ACRYLIC ACID	L	3	20	141	(130)			OR-LD50-R-340		X
ACRYLONITRILE	L	83	20	77	30	4,000		CP-HCN-IDLH-50	Decomposes to cyanides in fires; Carcinogenic	I
ADIPONITRILE	L			295	(200)		50		Estimated V.P. = 5 x 10 ⁻⁵ mm at 200 C.	X
ALDICARB	C							OR-LD50-R-0.9	Extremely toxic	I
ALDRIN	C	6x10 ⁻⁶	20	D	N.F.	(100)	(0.25)			X
ALLYL ALCOHOL	L	17	20	97	72	150	2.0			II
ALUMINUM ALKYL COMPOUNDS	L						(2)	RP-HCl-IDLH-100 CP-HCl-IDLH-100	Pyrophoric sol. HCl & Al ₂ O ₃ fume with air or H ₂ O	I

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV			
		mm	@ °C				ppm (mg/m³)	TLV		
ALUMINUM CHLORIDE	P/C	1	100	190 @ 2.5atm	N.F.		5.0	RP-HCl-IDLH-100	Hydrolyzes in H2O to form HCl	II
ALUMINUM FLUORIDE	C	1	1,238	1,537	N.F.			OR-LDLO-GP-600		X
ALUMINUM FORMATE	P									
ALUMINUM SULPHATE (DRY)	P				N.F.			IN-MOD-(SAX) OR-LD50-M-770		X
2-AMINOTHIAZOLE	C			D 90				OR-LD50-R-480 IN-MOD-(SAX)		III
AMMONIA (ANHYDROUS)	G(L)	10atm	26	- 34	none	500	25			III
AMMONIUM BICARBONATE	C			D	N.F.			IV-R-HIGH-(SAX)		X
AMMONIUM BIFLUORIDE	C			240	N.F.		(2.5)		TLV as fluorine	X
AMMONIUM BISULPHIDE	S			D						X
AMMONIUM BROMIDE	C	1	198							X
AMMONIUM CARBAMATE	C/P			S 60				IV-R-HIGH-(SAX)		X
AMMONIUM CARBONATE	C			D						X
AMMONIUM CHLORIDE	C	1	160	520	N.F.		(10)			X
AMMONIUM CHLOROPLATINATE	C			D				IN-TCLO-H-(.0009)		X
AMMONIUM FLUOBORATE	C			S						X
AMMONIUM FLUORIDE	C			D	N.F.		(2.5)		TLV as fluorine	X

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	T O G X R I J C U P I P T Y
	STATE	VAPOR PRESSURE	B.P.	FLASH POINT	IDLH	TLV	OTHER DATA			
mm	°C	°C	°F(CC)	ppm (mg/m³)						
AMMONIUM HYDROXIDE	L	475	15.5		N.F.	5,000	1.0		Liquid can inflict burns	III
AMMONIUM NITRATES	C			D 210	N.F.				Explodes easily if contaminated	X
AMMONIUM OXALATE	C			D 70					Combustible solid	X
AMMONIUM PHOSPHATES	C/P			D 100	N.F.					X
AMMONIUM PICRATE	C			423					Explodes at B.P. & when shocked	X
AMMONIUM SILICOFLUORIDE	S			D	N.F.		(2.5)			I
AMMONIUM SULPHATES	C				N.F.					X
AMMONIUM SULPHIDE	C			40	72			RP-NH ₃ -IDLH-500 RP-H ₂ S-IDLH-300	Shipped as fuming solution	II
AMMONIUM SULPHITE	C			S 150	N.F.					X
AMMONIUM THIOCYANATE	C			D 115				OR-LDLO-M-330	Combustible solid	X
AMMONIUM THIOSULPHATE	C			D	N.F.					X
n-AMYL ALCOHOL	L	1	14	138	77	150				II
AMYL CHLORIDE	L			108	34			CP-COCl ₂ -IDLH-2	HCl & COCl ₂ may be formed in fires	I
ANILINE	L	0.6	20	184	158	100	5		Heated to decomp. emit highly toxic fumes	II
ANILINE SULPHATE	C							OR-LDLO-H-50		X
ARSENIC	C	1	372	S 615			(0.2)		⁻⁴ Carcinogenic; VP<10 mm	X

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	°C							
ARSENIC ACID	C	5x10 ³	20	160	N.F.		(0.5)		TLV as Arsenic; VP est	I
ARSENIC TRICHLORIDE	L	10	24	131	N.F.			IN-LCLO-C-(100)(1)		I
ARSENIC TRIOXIDE	P			457	N.F.		(0.5)	IN-TCLO-H-(0.7)	TLV as Arsenic Carcinogenic	I
AZINPHOS-METHYL (GUTHION)	C	≈ 0	20	D	N.F.	(5)	(0.2)	OR-LD50-R-16	Potential dust problem	I
BARIUM OXALATE	C/P									X
BENZENE	L	75	20	81	12	2,000	10			II
BENEZENE SULPHONIC ACID	C							IN-MOD-(SAX)		X
BENZOIC ACID	P	1	96	249	250			OR-LD50-R-3040		X
BENZOYL CHLORIDE	L	1	32	197	162			IN-HIGH-(SAX) RP-HCl-IDLH-100	Carcinogenic;with H ₂ O → toxic & corrosive fumes	II
BENZOYL HYDRAZINE									Carcinogenic	X
BENZOYL PEROXIDE	S	< 1	20	D	Flam.	(1,000)	(5)		Decomp.→ diphenyl,C ₆ H ₆ , C ₆ H ₅ COOH,CO ₂ ;explosive	II
BENZYL ACETATE	L	1	45	212	216			IN-TCLO-H-15		I
BENZYL ALCOHOL	L	1	58	206	213			IN-LD50-R-1000		II
BENZYL CHLORIDE	L	0.9	20	179	140	10	1.0	CP-HCl-IDLH-100	Decomposes with metals; explosive → HCl	I
BERYLLIUM FLUORIDE	S			S 800	N.F.		(.002)			X
BORON TRIBROMIDE	L	40	14	91	N.F.		1.0	RP-HBr-IDLH-50	With H ₂ O → corrosive & toxic fumes of HBr	I

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV			
		mm	@ °C				ppm (mg/m³)			
BORON TRICHLORIDE	L	760	13	13	N.F.			RP-HCl-IDLH-100	Reacts with organic matter, grease & H ₂ O	II
BORON TRIFLUORIDE	G			-101	N.F.	100	1.0		With H ₂ O → corrosive & toxic fumes	II
BROMACIL	C						1.0			X
BROMINE	L	175	21	59	N.F.	10	0.1		Heated + with H ₂ O → corrosive & toxic fumes	I
BROMOTRIFLUOROMETHANE	G			-58				IN-LCLO-R-4000(½) RP-F ₂ -IDLH-25	Emit fumes of HBr, F ₂ & COF ₂	III
BUTADIENE	G	910	20	-4	-105	20,000	1,000			X
BUTANE	G	2	19	-0.5	-100		500			X
n-BUTYL ACRYLATE	L	3	20	145	(120)		10			I
n-BUTYL ALCOHOL	L	4	20	118	84	8,000	50		Heat to decomp. emits highly toxic fumes	III
BUTYLATED HYDROXYTOLUENE	C			265	260			OR-LD50-R-3510		X
t-BUTYL HYDROPEROXIDE	L			D	80-130			IN-LC50-R-500(4)		II
BUTYLLITHIUM	L(S)				-40-25				Ignites in moist air to form toxic fumes	III
BUTYL MAGNESIUM CHLORIDE	L									X
p-tert-BUTYL PHENOL	C			135	240			OR-LD50-R-2700		X
n-BUTYRALDEHYDE	L	92	20	76	20			OR-LD50-R-5 to 1500		X
CADMIUM BENZOATE	S			D						X

COMPOUND	PHYSICAL PROPERTIES						TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA			
		mm	@ °C								
									ppm (mg/m ³)		
CADMIUM CYANIDE	C			D						X	
CADMIUM NITRATE	C			132	N.F.		(0.2)		TLV as Cadmium; carcinogenic	X	
CADMIUM OXIDE	C	1	1,000	D 1559	N.F.		(0.1)	IN-TCLO-H-(8.6)	carcinogenic;	X	
CADMIUM SELENIDES	P							RP-H ₂ Se-IDLH-2	with H ₂ O → H ₂ Se fumes	X	
CADMIUM SULPHATE	C			D	N.F.		(0.2)		TLV as Cadmium; carcinogenic	X	
CADMIUM SULPHIDES	C			S in N ₂					carcinogenic	X	
CADMIUM SULPHOSELENIDE								IN-HIGH-(SAX)	no listing	X	
CALCIUM CYANIDE	C/P			D	N.F.		(5)	RP -HCN-IDLH-50	TLV as Cyanide; with H ₂ O → HCN fumes	II	
CALCIUM FLUORIDE	C/P			2,500	N.F.					X	
CALCIUM HYPOCHLORITE	P			D 100	N.F.			IN-HIGH-(SAX)	reacts with oil, grease & comb. mat.; explosive	X	
CALCIUM IODIDE	C			1,100						X	
CALCIUM ISODECANOATE									no listing	X	
CALCIUM NAPHTHENATE	S									X	
CALCIUM PHOSPHATES	P			D 200	N.F.			OR-LD50- >15,000		X	
CALCIUM PLUMBATE	C			D						X	
CALCIUM SULPHATE	C/P									X	

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	@ °C							
CAPROLACTAM	L	3	100	268	230		5		crystalline solid at room temperature	I
CARBARYL (SEVIN)	C	0.005	20	D	N.F.	(625)	(5)		carcinogenic	II
CARBOFURAN	C	2×10^{-5}	33				(0.1)			X
CARBON DISULPHIDE	L	300	20	46	-22	500	10	CP-SO ₂ -IDLH-100	SO ₂ emitted in fires	II
CARBON MONOXIDE	G			-190		1,500	50			III
CARBON TETRACHLORIDE	L	91	20	77	N.F.	300	10	CP-COCl ₂ -IDLH-2	carcinogenic	II
CARBONYL CHLORIDE (PHOSGENE)	G(L)	1,180	20	8.2	N.F.	2	0.1	RP-HCl-IDLH-100	with moisture → HCl & CO	I
CHLORAMPHENICOL	C									X
CHLORDANE	L	1×10^{-5}	20	D 175	132	27 (500)	(0.5)		carcinogenic	X
CHLORINE	L/G	4,800	20	-34	N.F.	25	1.0	RP-HCl-IDLH-100	with moisture → HCl	I
CHLORINE DIOXIDE	G			10	N.F.	10	0.1	RP-HCl-IDLH-100	conc. > 10% in air → explodes, toxic fumes HCl	I
CHLOROACETIC ACID	C/L	1	43	189	259			RP-COCl ₂ -IDLH-2 OR-LD50-R-76	decomp. → fumes of COCl ₂ & Cl ₂	X
CHLOROANILINE	S	1	59	230	(220)			IN-TCLO-H-(44) OR-LD50-R-300		X
CHLOROBENZENE	L	89	20	132	85	2,400	75	CP-COCl ₂ -IDLH-2 RP-HCl-IDLH-100	COCl ₂ & HCl formed in fires	I
CHLOROBUTANE	L			79	(15)			CP-COCl ₂ -IDLH-2	COCl ₂ formed in fires	I
CHLOROFLUOROETHANE	G			146-159	273					X

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOG X R I O C U P I T Y
	STATE	VAPOR PRESSURE	B.P.	FLASH POINT	OTHER DATA					
					IDLH	TLV				
							mm	@ °C		
CHLOROFORM	L	160	20	61	N.F.	1,000	10		Carcinogenic	II
2-CHLORO-4-PHENYL PHENOL	C			D 322	345			IN-MOD-(SAX) OR-LD50-R-4220		X
CHLOROSULPHONIC ACID	L	1	32	158	N.F.		5	RP-HCl-IDLH-100	With H ₂ O explodes → toxic fumes of HCl	I
CHROMIC ACID(CHROMIC TRIOXIDE)	C				N.F.	(30)	(0.1)		Carcinogenic; violent explosion	X
COAL TAR, CRUDE	L				405		(0.2)		Carcinogenic	X
COBALTOUS NAPHTHENATE	S							OR-LD50-R-3900		X
COPPER CYANIDE	P			D	100		(5)		TLV as cyanide	I
COPPER NAPHTHENATE	S			154-202	100		500			X
CREOSOTE	L			200-250	165				Carcinogenic	X
CRESOLS(CRESYLIC ACIDS)	L(S)	.1-.25	20	191-203	178	250	5			II
CUMENE (ISOPROPYL BENZENE)	L	8	20	153	115	8,000	50			X
CUMENE HYDROPEROXIDE	L			D 153	120			IN-LC50-R-220(4)	Decomposes violently	I
CYANOGEN IODIDE	C	1	25						Strong irritant to eyes & skin	III
CYANOPYRIDINE	L	0.001	20	195				RP-HCN-IDLH-50	Hydrolyzes in H ₂ O, forms CN; est. V.P. = .001 mm	I
CYCLOHEXANE	L	95	20	81	- 4	10,000	300			III
CYCLOHEXANOL	L	1	20	161	154	3,500	50			X

COMPOUND	PHYSICAL PROPERTIES					TOXICITY				COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE	B.P.	FLASH POINT	IDLH	OTHER DATA					
						°C	°F(CC)	TLV	ppm (mg/m³)		
CYCLOHEXANONE	L	2	20	157	111	5,000	50			X	
CYCLOHEXYLAMINE	L			135	(90)		10 (300)		Heat to decomp. emits toxic fumes	I	
CYCLOPENTANE	L	400	31	49	< 20		600		Hazard is primarily explosion	X	
CYCLOPENTANONE	L			125-126	87			IP-LD50-M-1950		X	
DDT	C/P	12x10 ⁻⁷	20	D	162-171		(1.0)			X	
DECABORANE	C	0.05	77	213	176	20	0.05		Self-ignites in air	I	
DEHYDROABIETYLAMINES	L			344	(375)			OR-LD50-R-390		X	
1,2-DIAMINOCYCLOHEXANE										III	
DIAZINON	L			84 @ .002 mm			.008 (0.1)		Action less severe than parathion	I	
DIBENZOTHAIZYL DISULPHIDE	C			D				OR-LD50-R-7000		X	
DIBORANE	G	244	- 112	- 93	- 130	40	0.1	CP-B ₂ O ₃ -TLV-(10)	Emits toxic fumes of boron oxides with H ₂ O	I	
DIBROMOMETHANE (METHYLENE DIBROMIDE)	L			110	N.F.			RP-HBr-IDLH-50	Emits toxic fumes of bromides	II	
DIBUTYLtin DILAURATE	L/S				(445)		(0.1)		TLV as Sn	X	
1,2-DICHLOROBENZENE	L	1	20	181	155	1,700	50			X	
1,4-DICHLOROBENZENE	C	0.4	20	174	150	1,000	75			II	

COMPOUND	PHYSICAL PROPERTIES						TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA			
		mm	@ °C								
DICHLORODIFLUOROMETHANE (FREON 12)	G	5atm	16	- 30	N.F.	50,000	1,000			X	
DICHLOROMETHANE (METHYLENE DICHLORIDE)	L	350	20	40	N.F.	5,000	200			III	
2,4-DICHLOROPHENOL	C	1	53	216	237			OR-LD50-R-580		X	
2,4-D(DICHLOROPHENOXACETIC ACID)	P	= 0	20	D 160		(500)	(10)		Combustible solid; carcinogenic	II	
1,3-DICHLOROPROPENE	L			103-110	95			IN-LC50-H-1000(4)	Toxic gases produced in fire	II	
2,3-DICHLOROPROPENE	L							IN-LCLO-R-500(4)	Reacts violently with Aluminum	II	
DICHLOROTETRAFLUROETHANE	G	1,444	20	4	N.F.	50,000	1,000		M.P. = 208°C	X	
DICYANDIAMIDE(CYANOQUANIDINE)	C				N.F.					X	
DIELDRIN	C	2x10 ⁻⁷	20	D	N.F.	(450)	(0.25)			X	
DIETHYL AMINE	L	195	20	56	- 15	2,000	25			III	
DIETHYL ANILINE	L	1	50	216	185			OR-LD50-R-2690		X	
DIETHYL ETHER	L	442	20	95	- 49	19,000	400			X	
DIETHYL SULPHATE	L	1	47	D	220			IN-LDLO-R-250(4) RP-H ₂ SO ₄ -IDLH-(80)	Moisture → forms H ₂ SO ₄ ; carcinogenic	II	
DIISOBUTYLENE	L	0.001	20	102	35			IN-MOD-(SAX)	Est. V.P.	II	
DIISOBUTYL KETONE	L	8	20	163	120	2,000	25			X	
DIISOPROPANOLAMINE	S	0.2	42	249	(260)			OR-LD50-R-6720		X	

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	°C							
DIMETHOATE	S							OR-LD50-H-30	M.P. = 50°C	II
DIMETHYLAMINE	G(L)	2atm	20	7	(20)	2,000	10			III
DIMETHYL ETHER	G(L)			- 25	- 42			IN-MOD-(SAX)		II
n,n-DIMETHYLFORMAMIDE	L	3	20	- 61	136	3,500	10			X
DIMETHYL SULPHATE	L	0.5	20	189	182	10	1			I
DIMETHYL SULPHIDE	L			37	- 36			OR-LD50-R-535 RP-SO2-IDLH-100	Emits toxic fumes of SOx in fires	II
DIMETHYL SULPHOXIDE	L	0.4	20	189	190			OR-LD50-M-21000		X
DINITRO-O-SEC. BUTYL PHENOL	C							OR-LD50-R-25		X
2,4-DINITROTOLUENE (DNT)	C	1	20	70	404	(200)	(1.5)			I
DIOCTYL SODIUM SULPHOSUCCINATE	S/L							OR-LD50-R-1900		X
1,4-DIOXANE	L	29	20	101	54	200	100		Carcinogenic	II
DIPHENYL	C	1.4×10^{-4}	20	255	235	(300)	0.2		Est. V.P.	I
DIPHENYLAMINE	C	1	108	302	307		(10)			I
DIPHENYL METHANE 4,4-DIISOCYANATE	C	0.001	40	392	(425)		0.02			I
DIPHENYLMERCURY DODECENYL SUCCINATE										X
n,n-DIPHENYL-PARA-PHENYLENEDIAMINE	S							OR-LD50-R-2370		X

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOG X R O I C U P I T Y
	STATE	VAPOR PRESSURE		B.P. °C	FLASH POINT °F(CC)	IDLH ppm (mg/m³)	TLV	OTHER DATA		
		mm	@ °C							
DIQUAT	C						(0.5)			II
DIVINYLBENZENE	L	1	33	200	165		10			I
DODECYL MERCAPTAN	L			200-235	(205)					X
PARA-DODECYLPHENOL	L			154-168	(325)			OR-LD50-R-2140		X
DODINE (CYPREX)	C							OR-LD50-R-566		X
ENDRIN	C	2x10 ⁻⁷	20	D 200	N.F.	(200)	(0.1)		Emits toxic fumes of COCl ₂ in fires	X
EPICHLOROHYDRIN	L	13	20	115	100	100	2	CP-COCl ₂ -IDLH-2		I
EPOXY RESINS										X
ETHYL ACETATE	L	76	20	77	24	10,000	400			III
ETHYL ACRYLATE	L	30	20	100	48	2,000	25			III
ETHYLBENZENE	L	7	20	136	59	2,000	100			III
ETHYL BUTYRALDEHYDE	L	14	20		(70)			IN-LCLO-R-8000(4)		X
ETHYL CHLORIDE	L	1,064	20	12	- 58	20,000	1,000	CP-COCl ₂ -IDLH-2	Emits toxic fumes of COCl ₂ in fires	I
ETHYLENE	G			- 104	-213			IN-MOD-(SAX)	Dangerous fire and explosion risk	X
ETHYLENE DIAMINE	L	11	20	117	150	2,000	10		Carcinogenic Emits toxic fumes of Br ₂	III
ETHYLENE DIBROMIDE	L	11	20	131		400	20	RP-HBr-IDLH-50		II

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY		
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	OTHER DATA					
		mm	@ °C				°C	°F(CC)			ppm (mg/m³)	TLV
ETHYLENE DICHLORIDE	L	62	20	84	55	1,000	50	CP-COCl ₂ -IDLH-2	COCl ₂ & HCl generated in fires	I		
ETHYLENE GLYCOL	L	0.05	20	198	232	6,000	200			X		
ETHYLENE GLYCOL DINITRATE	L	0.05	20	114		80	0.2		Explodes at B.P.;major risk is explosion	II		
ETHYLENE GLYCOL MONOETHYL ETHERS	L	4	20	135	202		200			X		
ETHYLENE GLYCOL MONOETHYL ETHER ACETATE	L	1	20	(117)		2,500	100			III		
ETHYLENE GLYCOL MONOMETHYL ETHERS	L	6	20	125	107		25			II		
ETHYLENEIMINE	L	160	20	56	12		0.5			I		
ETHYLENE OXIDE	G	1,097	20	11	< 0	800	50		Explosion hazard is severe	II		
ETHYL MERCAPTAN	L	442	20	34	- 55	2,500	0.5			II		
ETHYL METHACRYLATE	L			117	80			OR-LDLO-R-3630	Explosion hazard only	X		
FENTANYL CITRATE												
FERRIC CHLORIDE	S	1	194	D 319	N.F.		(1)		TLV as Fe	X		
FERROUS SULPHIDE	C									X		
FERROSILICON	C									X		
FERROUS PHOSPHIDE	P							RP-PH ₃ -IDLH-200	With moisture evolves PH ₃ ; M.P. = 1290°C	II		
FLUOBORIC ACID	L			D 130								

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY	
	STATE	VAPOR PRESSURE	B.P.	FLASH POINT	IDLH	TLV					
						mm	@ °C	°C			ppm (mg/m³)
FLUORINE	G	>1atm	20	- 188	N.F.	25	1.0		Explosion and fire hazard → toxic fumes	I	
FLUOSILICIC ACID	L			D 100	N.F.			OR-LDLO-GP-200 RP-F ₂ -IDLH-25		X	
FORMALDEHYDE (COMMERCIAL SOLUTION)	L	827	38	- 19	122-182	100	2			II	
FORMAMIDE	L	30	129	D 210	(310)		200		At flash point vapours burn	II	
FORMIC ACID	L	23-33	20	101	138	100	5			II	
FURFURYL ALCOHOL	L	1	32	170	149	250	5		Explosion and fire hazard	II	
GANGLIOSIDE										X	
GLYOXAL	L			50	N.F.			OR-LD50-GP-760		X	
HEPTACHLOR	C	.0004	20	D	N.F.	(100)	(0.5)		Potential dust problem	I	
HEPTANE	L	40	20	98	25	4,250	500			III	
HEXAMETHYLENEDIAMINE	S/L	0.0013	20	205	(160)			IN-MOD-(SAX)	Est. V.P.	II	
HEXAMETHYLENEIMINE	L	0.018	20	132	(99)			IN-LCLO-R-4800(4)	Est. V.P.	I	
HEXAMETHYLENETETRAMINE (HEXAMINE)	P				482			OR-LC50-H-500-5000		X	
HYDRAZINE	L	10	20	114	(100)	80	1		Explosives; decomp. forms fumes of N compounds	II	
HYDROCHLORIC ACID	L	4	18	- 85	N.F.		5			II	
HYDROFLUORIC ACID	L	400	3	67	N.F.		3			I	

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	@ °C							
HYDROGEN CHLORIDE (ANHYDROUS)	G	>1atm	20	- 85	N.F.	100	5			II
HYDROGEN FLUORIDE	L	780	20	20	N.F.	20	3		Attacks glass,concrete metals, rubber	I
HYDROGEN PEROXIDE	L	1	15	125	N.F.	75	1			II
HYDROGEN SULPHIDE	G	20atm	26	- 60	260	300	10			II
HYDROQUINONE	C	<.001	20	285	329	(20)	(2)			X
2-HYDROXY METHYL-2-NITRO-1,3-PROPANE										X
HYPHOPHOSPHORUS ACID	L/C			D						X
IODINE	C	0.3	20	184	N.F.	10	0.1			X
										I
ISOAMYL ALCOHOL	L	2	20	132	109	8,000	100		Moderate fire hazard	III
ISOBUTANOL	L	9	20	108	82	8,000	100		Emits toxic fumes when heated	III
ISOBUTYLENE	G(L)			- 7	- 105		1,000			X
ISOBUTYL METHYL KETONE(MIBK)	L	16	20	118	73	3,000	100		Dangerous fire and explosion hazards	III
ISOPHORONE	L	0.2	20	215	184	800	10		Moderate fire hazard	II
ISOPRENE	L	400	15	34	- 65					X
ISOPROPYL ETHER	L	119	20	69	- 18	10,000	250			X
LEAD COMPOUNDS	C/P						(0.05)		TLV as Pb	X

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	@ °C							
LIME (CALCIUM OXIDE)	C	0	20	2,850	N.F.	(250)	(5)		Powerful caustic; potential dust problem	II
LINDANE	P	9x10 ⁻⁶	20	D	N.F.	(1,000)	(0.5)			X
MAGNESIUM FLUORIDE	C			2,239				OR-LDLO-GP-1000		X
MALATHION	L	4x10 ⁻⁵	20	D 156	> 325	³⁷⁰ (5,000)	(15)			X
MALEIC ACID	C			D 135				OR-LD50-R-708		X
MALEIC ANHYDRIDE	C	0.16	20	200	215		0.25		Carcinogenic	I
MALEIC HYDRAZIDE	C			D				OR-LD50-R-3800		X
MELAMINE	C	50	315	S				OR-LDLO-M-1600		X
MERCURIC NITRATE	P			D	N.F.		(.05)	RP-Hg-IDLH-(28) RP-NOx-IDLH-50	TLV as Hg; with wood, paper → vaps. of Hg & NOx	I
MERCUROUS NITRATE	C			D	N.F.		(.05)			X
MERCURY	L	.0012	20	357	N.F.	3.4 (28)	.006 (0.1)		Heated emits highly toxic fumes	I
MESITYL OXIDE	L	8	20	130	87	5,000	25			X
METHACRYLIC ACID	L/C	1	26	161	(177)			IP-LD50-R-48	Decomp. emits toxic fumes	II
METHOXYCHLOR (DMDT)	C			D		(7,500)	(10)			X
METHYL ACETATE	L	173	20	57	14	10,000	200			III
METHYL ACRYLATE	L	68	20	81	(27)	1,000	10			II

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	OTHER DATA			
		mm	@ °C				ppm (mg/m ³)	TLV		
METHYLAMINE	G(L)	2atm	10.1	- 7	32	100	10	CP-NOx-IDLH-50	NOx generated in fires	I
METHYLAMYL ACETATE	L	4	20	146	113	4,000	50			X
METHYL BROMIDE	G(L)	1,824	25	4	N.F.	2,000	15			I
METHYL CHLORIDE	G	4.8atm	20	- 24	< 32	10,000	100	CP-HCL-IDLH-100	Emits toxic fumes of chlorides in fires	I
METHYL CHLOROPHENOXACETIC ACID	C							OR-LD50-R-700		X
METHYLENE DIANILINE	C				440		0.1		Carcinogenic.	III
METHYLENE IODIDE	L	0.1	20	181				RP-I ₂ -IDLH-10	Est. V.P.	I
METHYL ETHYL KETONE	L	70	20	80	21	3,000	200			III
METHYL ETHYL KETONE PEROXIDE	L						0.2		Emits toxic fumes when heated	I
METHYL ETHYL PYRIDINE	L			178	(155)		1,770		TLV for 3.7 hrs.	X
METHYL IODIDE	L	375	20	43	N.F.	800	5	RP-I ₂ -IDLH-10		II
METHYL ISOBUTYL CARBINOL	L	4	20	132	106	2,000	25			X
METHYL MERCAPTAN	G(L)	>1atm	20	6	(0)	400	0.5	CP-SO ₂ -IDLH-100	Emits toxic fumes of SOx in fires	II
METHYL METHACRYLATE	L	3	20	101	(50)	4,000	100			III
METHYL PARATHION	C				(115)		0.2		B.P. is very high	X
METHYL PROPYL BENZENE(CYMENE)	L	1	17	177	117			OR-TDLO-H-86		X

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICOLOGICAL TYPE
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	OTHER DATA			
		mm	@ °C							
METHYL-P-TOLUENESULPHONATE	C							OR-LDLO-R-1000	Carcinogenic	X
MOLYBDENUM TRIOXIDE	P			1,155	N.F.		(10)			I
MONOCHLORODIFLUOROMETHANE	G(L)			- 41	N.F.		1,000			X
MONOETHANOLAMINE	L	6	60	170	185		3			X
MONOSODIUM METHANE ARSONATE (MSMA)	C			D	N.F.			OR-LD50-R-500-5000		X
MORPHOLINE	L	7	20	128	95	8,000	20	CP-NOx-IDLH-50	Emits highly toxic fumes of NOx	I
NAPHTHA, Coal tar	L	< 5	20	149-216	100-109	10,000	100			III
NAPHTHALENE	C	0.05	20	218	174	500	10			II
α-NAPHTHOL	C	1	94	282				OR-LD50-R-2590		X
NICKEL CARBONYL	L	321	20	43	< -4	0.001	0.001		carcinogenic; emits toxic fumes in fire	I
NITRIC ACID	L	62	25	83	N.F.	100	2			II
NITROBENZENE	L(C)	<<1	20	211	190	200	1			II
NITROGEN DIOXIDE	G(L)	720	20	21	N.F.	50	5			I
NITROHYDROCHLORIC ACID	L							IN - HIGH - (SAX)		I
n-NITROSODIPHENYLAMINE	P							OR-LD50-R-1650	carcinogenic	X
NITROUS OXIDE	G			-90	N.F.			IN-LCLO-M-1500		III

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	OTHER DATA			
		mm	@ °C				TLV			
								ppm (mg/m³)		
NONYL PHENOL	L			304	285					X
OCTYL PHENOL	C			280	72			CP-C ₆ H ₅ OH-IDLH-100	decomp. → toxic fumes of phenols	II
OXALIC ACID	S	<.001	20	S 150	N.F.	(500)	(1)			II
PARAFORMALDEHYDE	P			D@ 1 atm	160		5	CP-HCHO-IDLH-100	Liberates HCHO	II
PARAQUAT	S	≈ 0	20	D	N.F.	(1.5)	(0.5)			X
PARATHION	L	.0004	20	D 375	N.F.	1.7 (20)	(0.1)			I
PENTABORANE	L	171	20	58	86	3	.005		ignites spont. in air; emits toxic fumes	I
PENTACHLOROETHANE	L			162			0.06 (0.5)			I
PENTACHLOROPHENOL	C	.0002	20	D 310	N.F.	(150)	(0.5)	RP-HCl-IDLH-100		I
PERCHLOROETHYLENE	L	16	22	121	N.F.		100	RP-HCl-IDLH-100		II
o-PHENETIDINE	L	1	67	229	241			IN-HIGH-(SAX)		I
PHENOL (CARBOLIC ACID)	C	0.2	20	182	174	100	5		carcinogenic	II
PHENYLMERCURIC ACETATE	C						(.05)			X
PHENYLMERCURIC OLEATE	P						(.05)			I
PHOSPHINE OXIDE(MAPO-METEPA)										
PHOSPHORIC ACID	L	0.03	20	>130	N.F.		0.25 (1)			I

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE	B.P.	FLASH POINT	IDLH	TLV	OTHER DATA			
mm	@ °C	°C	°F(CC)	ppm (mg/m ³)						
PHOSPHORUS PENTACHLORIDE	C	1	55	S 162	N.F.	(200)	0.1	RP-HCl-IDLH-100	with H ₂ O emits toxic fumes of HCl	II
PHOSPHORUS PENTASULPHIDE	C	1	572	514	Flam.	(750)	(1.0)	RP-H ₂ S-IDLH-300	liberates H ₂ S, P ₂ O ₅ with H ₂ O	II
PHOSPHORUS PENTOXIDE	P	1	384	S 300					hydrolyses to H ₃ PO ₄	I
PHOSPHORUS PYRIDIDE									no listing	X
PHOSPHORUS SESQUISULPHIDE	C			407				OR-LDLO-R-100	with H ₂ O→fumes of SO _x , PO _x	II
PHOSPHORUS TRICHLORIDE	L	100	20	74		50	0.5	RP-HCl-IDLH-100	emits toxic fumes of HCl & PO _x with H ₂ O	I
PHOSPHORUS, YELLOW	C	0.026	20	280	>86		(0.1)		emits fumes of PO _x ; spont. in air	I
PHTHALIC ANHYDRIDE	C	<.05	20	285	304	10000	2			X
PIPERAZINE POLYCHLORINATED BIPHENYLS (PCB)	C			148-340	(225)			OR-LD50-R-3800		X
	L	<1	150	375	>286		(0.5-1.0)			II
POLYPHOSPHORIC ACID	L			550	N.F.					X
POTASSIUM	S			774						X
POTASSIUM BROMATE	C/P			D 370						X
POTASSIUM CHLORATE	C/P			D 400	N.F.			OR-LDLO-RB-2000		X
POTASSIUM CHLOROPLATINATE	C			D 250				IN-HIGH-(SAX)		X
POTASSIUM COPPER CYANIDE	C								Hydrolyses to HCN	II

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	T O G X R O I O C U P I T Y
	STATE	VAPOR PRESSURE		B.P. °C	FLASH POINT °F(°C)	IDLH ppm (mg/m ³)	TLV	OTHER DATA		
		mm	@ °C							
POTASSIUM CYANIDE	C	≈0	20		N.F.	(50)	(5)		potential dust hazard	I
POTASSIUM DICHROMATE	C			D 500	N.F.			IN-HIGH-(SAX)		X
POTASSIUM FERROCYNANIDE	C			D				RP-HCN-IDLH-50		X
POTASSIUM FLUORIDE	P	1	885	1500				OR-LD50-R-245		X
POTASSIUM HYDROXIDE	L(C)			1320	N.F.		0.9 (2)			X
POTASSIUM IODIDE	S	1	745	1420	N.F.			OR-LDLO-M-1862		X
POTASSIUM OXALATE	C			D@1atm	N.F.			OR-LD50-50-500		X
POTASSIUM SULPHATE	C/P									X
POTASSIUM THIOCYANATE	C			D 500				OR-LDLO-H-80		X
1-PROPANETHIOL	L			67	5			IN-LC50-R-7300(4) CP- SO ₂ -IDLH-100	highly flammable, SO ₂ generated	II
PROPIONALDEHYDE	L			48	(15-19)			IN-LCLO-R-8000	fire hazard; flash backs can occur	III
n-PROPYL ALCOHOL	L	15	20	97	77	4000	200		moderate explosion hazard	III
PROPYLENE DICHLORIDE	L	40	20	96	60	2000	75		dangerous fire hazard	III
PROPYLENE GLYCOL ACETATE										
PROPYLENE OXIDE	L	442	20	34	-35	2000	100		severe explosion hazard	X
PYRIDINE	L	18	20	115	68	3600	5	CP-HCN-IDLH-50	emits highly toxic fumes of cyanides	III I

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	@ °C							
2-PYRROLIDONE	L			245	(265)			OR-LD50-R-6500		X
QUINOLINE	L	1	60	273	225			OR-LD50-R-460		X
SILICA (SILICON DIOXIDE)	P	≈0	20	2230	N.F.		20		TLV units are mppcf	X
SILICON TETRACHLORIDE	L	0.25	20	58	N.F.			IN-LC50-R-8000(4) RP-HC1-IDLH-100	moisture→toxic fumes of HC1; Est.VP	II
SILVER CYANIDE	P			D 320			(0.01)			I
SODIUM	S	1.2	400	883						X
SODIUM ARSENITE	P			D	N.F.		(0.5)		TLV as Arsenic; carcinogenic	II
SODIUM BENZENE SULPHONATE										X
SODIUM BISULPHITE	C			D	N.F.		(5)			X
SODIUM BORATE	C			D 1575	N.F.			OR-LDLO-H-214		X
SODIUM BOROHYDRIDE	P			D				OR-LDLO-R-160		X
SODIUM BROMIDE	C	1	806	1390				OR-LDLO-R-580		X
SODIUM CHLORATE	C			D	N.F.			OR-TCLO-H-800		X
SODIUM CHLORITE	C			D 175						X
SODIUM CHLOROPLATINATE	P							IN-TCLO-H-(0.9)		II
SODIUM COPPER CYANIDE	C									II

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	T O X I C I T Y
	STATE	VAPOR PRESSURE		B. P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	°C							
SODIUM CYANIDE	P	1	817	1496	N.F.	(50)	(5)		potential dust hazard	I
SODIUM DICHROMATE	C			D 400	N.F.			SC-LDLO-GP-335	carcinogenic	X
SODIUM DIETHYLDITHIOCARBAMATE	C							OR-LD50-R-2050	carcinogenic;emits	X
SODIUM DODECYLBENZENESULPHONATE	P							OR-LD50-R-1260		X
SODIUM FLUORIDE	C	1	1077	1700	N.F.			OR-LD50-R-1800		X
SODIUM HYDROGEN SULPHIDE	L			100	N.F.			OR-LD50- 500 to 5,000		X
SODIUM HYDROXIDE	S	≈0	20	2534	N.F.	(200)	(2)			X
SODIUM HYPOCHLORITE	L			D	N.F.					X
SODIUM HYPOPHOSPHITE	P							IP-LD50-M-1584		X
SODIUM LAURYL SULPHATES	C(L)				N.F.			OR-LD50-R-1288		X
SODIUM NITRATE	C			D 380				OR-LDLO-R-200		X
SODIUM OXALATE	P			D	N.F.			OR-LD50-50 to 500		X
SODIUM OXIDE	C			S 1275						X
SODIUM PEROXIDE	P			D 460						X
SODIUM PHENOLATE	C									X
SODIUM PHOSPHATES	C/P			D	N.F.					X

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	@ °C							
SODIUM PRUSSATES	C				N.F.					X
SODIUM SELENATE	C						(0.2)		TLV as Se	X
SODIUM SELENITE	C						(0.2)		TLV as Se; carcinogenic	X
SODIUM STANNATE	C						(2)		TLV as Sn; decomposes in air	X
SODIUM SULPHANETHAZINE										X
SODIUM SULPHATE	C/P									X
SODIUM SULPHIDE	C							OR-LD50-H-50-500	B.P. very high; mod. flammable solid	X
SODIUM SULPHITE	P			D	N.F.			OR-TDLO-H-6		III
SODIUM THIOSULPHATE	C									X
SODIUM TOLUENE SULPHONATE	C							OR-TDLO-H-300		X
SODIUM TRIDECYL SULPHONATES										X
STANNOUS FLUORIDE	P						(2)		TLV as Sn	II
STANNOUS SULPHATE	C									X
STRONTIUM CHROMATE	C								carcinogenic	X
STRONTIUM NITRATE	P									X
STYRENE	L	5	20	145	88	5000	100			III

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B. P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	@ °C							
SULPHAMIC ACID	C			D>200	N.F.		(10)			X
SULPHUR	S(L)	1	184	445	405					X
SULPHUR DIOXIDE	G(L)	2538	21	-10	N.F.	100	2		with H ₂ O liberates toxic and corrosive fumes	II
SULPHUR MONOCHLORIDE	L	7	20	136	245	10	1	RP-HCl-IDLH-100	with moisture emits toxic fumes of HCl	I
SULPHUR TRICHLORIDE									no listing	X
SULPHUR TRIOXIDE	C(L)							RP-H ₂ SO ₄ -IDLH-(80)	Hydrolyses to H ₂ SO ₄	I
SULPHURIC ACID	L	<.001	20	340	N.F.	20 (80)	(1)			I
SULPHUROUS ACID	L							IN-HIGH-(SAX)		II
TETRABROMOETHANE	L			151 @ 54 mm				OR-LD50-R-400		X
TETRACHLOROETHANE	L	8	20	146	N.F.	150	5			II
TETRACHLOROPHENOL	S	1	100	D 288				OR-LD50-R-140		X
TETRAETHYLLEAD	L	0.2	20	D 198- 202	200	3 (40)	(0.1)		decomp. in sunlight; moderate fire hazard	I
TETRAETHYLTHIURAM DISULPHIDE	C			225-240 @ 3 mm				OR-LD50-R-2050		X
TETRAHYDROFURAN	L	145	20	66	6	20000	200	CP-H ₂ O ₂ -IDLH-75	primary risk is explosion	X
TETRAHYDRONAPHTHALENE	L	1	38	31	176		25			II
TETRAMETHYLLEAD	L	22	20	110	100	3.6 (40)	(0.15)			I

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	°C							
TETRAMETHYLTHIURAM DISULPHIDE	C	≈ 0	20	D	192	(1500)	(5)			X
TETRAMETHYLTHIURAM MONOSULPHIDE	P							OR-LDLO-C-100		X
THIOGLYCOLIC ACID	L	1	60	104-106 @ 11 mm			1	RP-H ₂ S-IDLH-300	evolves H ₂ S	III
THIOUREA	P			D				OR-TDLO-H-1600	carcinogenic	X
TITANIUM TETRACHLORIDE	L	10	21	136	N.F.		5	RP-HCl-IDLH-100	highly corrosive; with moisture liberates HCl	I
TOLUENE	L	22	20	111	40	2000	100		emits toxic fumes in fires	III
TOLUENE 2,4-DIISOCYANATE	L(S)	≈.04	20	250	(270)	10	0.02			I
p-TOLUENE SULPHONIC ACID	S			D 140				OR-LD50-M-400		X
o-TOLUIDINE	L	1	44	200	85	100	5		carcinogenic; emits toxic fumes in fires	II
TOXAPHENE	S	0.2-0.4	20	D	275	(200)	(0.5)			I
TRIBUTOXYETHYL PHOSPHATE	L	0.03	150	200-230 @ 4 mm	435			OR-LD50-GP-3000		X
TRI-n-BUTYL BORATE	L			230	(200)			OR-LD50-M-1740		X
TRI-BUTYL PHOSPHATE	L	very low		292	330	119 (1300)	(5)			II
TRIBUTYL PHOSPHINE	L			240	104			OR-LD50-R-750		X
1,2,4-TRICHLOROBENZENE	L	1	38	213	230		5			I
1,1,1-TRICHLOROETHANE	L	100	20	74		1000	350			II

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	T O X I C I T Y
	STATE	VAPOR PRESSURE		B. P.	FLASH POINT	IDLH	TLV			
		mm	°C							
TRICHLOROETHYLENE	L	58	20	87	90	1000	100			II
TRICHLOROISOCYANURIC ACID	C			D	N. F.			OR-LD50-R-700-800 RP-HC1-IDLH-100	contact with oil, grease sawdust+fire Cl ₂ & CO	I
2,4,5-TRICHLOROFLUOROMETHANE	G(L)	690	20	24	N. F.	10000	1000			III
2,4,5-TRICHLOROPHENOXYACETIC ACID	C	≈0	20	D	N. F.	(5000)	(10)			X
TRICHLOROTRIFLUOROETHANE	G			46	N. F.	4500	1000		carcinogenic	III
TRICRESYL PHOSPHATES	L	0.001	20	410	437		0.007 (0.1)			I
TRIDECYL BENZENE SULPHONIC ACID	L			D	(395)			OR-LD50-R-500-5000		X
TRIETHANOLAMINE	L	10	205	D	355			OR-LD50-GP-8000		X
TRIETHANOLAMINE DODECYL BENZENE SULPHONATE	L									X
TRIETHANOLAMINE OLEATE									combustible	X
TRIETHANOLAMINE STEARATE	S								combustible	X
TRIETHYLAMINE	L	0.08	20	90	(20)		25		est. V.P.	II
TRIFLURALIN	S			D139-140 @ 4 mm	>(185)			OR-LD50-R-500		X
TRIMETHYLAMINE	G(L)	4.6 ^x 10 ⁻⁴		3	20			SC-LDLO-RB-800	est. V.P.	X
1,2,4-TRIMETHYL BENZENE	L		20	169	130		25			II
2,2,4-TRIMETHYLPENTANE	L	41	21	99	10			IN-MOD-(SAX)		II

COMPOUND	PHYSICAL PROPERTIES					TOXICITY			COMMENTS	TOXICITY
	STATE	VAPOR PRESSURE		B.P.	FLASH POINT	IDLH	TLV	OTHER DATA		
		mm	°C							
TRIPHENYL PHOSPHITE	S/L			155-160 @ 0.1mm	(425)			OR-LD50-R-1600		X
TRIPROPYL TIN METHACRYLATE										X
TURPENTINE	L	5	20	150-160	95	1900	100			X
VALERALDEHYDE	L			103	(54)			OR-LD50-R-3200		X
VANADIUM NAPHTHENATE										X
VANADIUM PENTOXIDE	P	≈ 0	20	D 1750	N.F.	(70)	(0.5)			II
VINYL ACETATE MONOMER	L	100	22	73	18		10		burns and emits acrid fumes	I
VINYL CHLORIDE MONOMER	G(L)	2300	20	-14	(-110)		5	CP-COCl ₂ -IDLH-2	emits toxic fumes of COCl ₂ , HCl, CO in fires	I
VINYLDENE CHLORIDE	L			32	(0)		10	CP-COCl ₂ -IDLH-2	carcinogenic; emits COCl ₂ , HCl in fires	I
VINYL TOLUENE	L	1.1	20	168	127	5000	100			X
XYLENES	L	<10	20	132-144	63-84	10000	100		moderate explosion hazard	III
O-XYLENOL	L(S)	1	62	212	186		45		carcinogenic	II
ZINC ACETATE	C			D	N.F.			OR-LD50-R-2460		X
ZINC CHLORIDE	C	1	428	732	N.F.	(2000)	(1)			X
ZINC CHROMATE	S			D	N.F.		(.05)			X
ZINC CYANIDE	C			D 800				IN-HIGH-(SAX)		X

[illegible]

ASSIGNMENT OF CHEMICALS TO QUANTITY GROUPS

Throughout Appendix 3, all quantities are presented in pounds and the following table is used for converting quantity units. A list of chemical symbols is also given below.

1	ounce
2	pound
3	ton
4	short ton
5	metric ton
6	barrel

Chemical Symbols

APPENDIX 3

ASSIGNMENT OF CHEMICALS TO QUANTITY GROUPS

Al ₂ O ₃	aluminum oxide
As ₂ O ₃	arsenic oxide
CaO	calcium oxide
Ca(OH) ₂	calcium hydroxide
CaSO ₄	calcium sulfate
CaSiO ₃	calcium silicate
CO	carbon monoxide
CO ₂	carbon dioxide
Cr ₂ O ₃	chromium oxide
Fe	iron
Fe ₂ O ₃	iron oxide
Fe ₃ O ₄	iron(II,III) oxide
FeS	iron(II) sulfide
FeSO ₄	iron(II) sulfate
Fe ₂ (SO ₄) ₃	iron(III) sulfate
Fe ₃ (PO ₄) ₂	iron(III) phosphate
Fe ₂ (PO ₄) ₃	iron(III) phosphate
Fe ₃ (PO ₄) ₂	iron(III) phosphate
Fe ₂ (PO ₄) ₃	iron(III) phosphate

GLOSSARY OF ABBREVIATIONS AND SYMBOLS

Throughout Appendix 3, all quantities are presented in tonnes and the following coding system has been used for identifying quantity data. A list of chemical symbols is also given below:

E	Export
t	tonnes
P	Production
s	Sales
S	Shipment
U	Use

CHEMICAL SYMBOLS

Al_2Cl_6	aluminum trichloride
AsH_3	arsine
CH_3CN	methyl cyanide
CH_3NH_2	methylamine
CH_3SH	(methyl mercaptan)
$\text{C}_2\text{H}_4\text{Cl}_2$	dichloroethylene
$\text{C}_3\text{H}_5\text{OCl}$	epichlorohydrin
$\text{C}_6\text{H}_4\text{N}_2$	cyanopyridine
ClSO_3H	chlorosulphonic acid
CO	carbon monoxide
COCl_2	phosgene
HCl	hydrogen chloride
HCN	hydrogen cyanide
NO_x	oxides of nitrogen
PH_3	phosphine
PO_x	oxides of phosphorus
S_2Cl_4	sulphur monochloride
SO_x	oxides of sulphur

COMPOUNDS	TOXICITY	T O X I C I T Y	DISTRIBUTION				ONTARIO SPILLS 1975-79	D I S T R I B .	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)			TOTAL				
			DOMESTIC ORIGIN	IMPORTS						
ACETALDEHYDE		III		10,039	10,039		B		Reject	
ACETIC ACID		II	U 14,864			14,864	B		Accept	
ACETIC ANHYDRIDE		II	U 552 E 11,144			11,696	B		Accept	
ACETOACETANILIDE		X		1,357		1,357	C		Reject	
ACETONE		X	S 31,500	1,900		33,400	A		Reject	
ACETONITRILE		I		694		694	C	Both HCN and CH ₃ CN are toxic agents	Accept	
ACETYL CHLORIDE		I								
ACROLEIN		I								
25										
ACRYLAMIDE		I		598		598	C		Accept	
ACRYLIC ACID		X		800		800	C		Reject	
ACRYLONITRILE		I		25,340		25,340	B		Accept	
ADIPONITRILE		X	E 1,539	6,261		7,800	B		Reject	
ALDICARB		I								
ALDRIN		X	U 23			23	X		Reject	
ALLYL ALCOHOL		II		31		31	X		Reject	
ALUMINUM ALKYL COMPOUNDS		I	P 450			450	X		Reject	

COMPOUNDS	T O X I C I T Y G R O U P	DISTRIBUTION			ONTARIO SPILLS 1975-79	D I S T R I B . G R O U P	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
ALUMINUM CHLORIDE	II	S 12,500	950	13,450		B	Toxic agents are HCl and Al ₂ Cl ₆	Accept
ALUMINUM FLUORIDE	X							Reject
ALUMINUM FORMATE								
ALUMINUM SULPHATE (DRY)	X	S 202,000	5,000	207,000	1	X		Reject
2-AMINOTHIAZOLE	III							
AMMONIA (ANHYDROUS)	II	S 3,260,000	65,000	3,325,000	2	A		Accept
AMMONIUM BICARBONATE	X							
AMMONIUM BIFLUORIDE	X		167	167		X		Reject
AMMONIUM BISULPHIDE	X							
AMMONIUM BROMIDE	X							
AMMONIUM CARBAMATE	X							
AMMONIUM CARBONATE	X							
AMMONIUM CHLORIDE	X		2,200	2,200		C		Reject
AMMONIUM CHLOROPLATINATE	X							
AMMONIUM FLUOBORATE	X							
AMMONIUM FLUORIDE	X							

COMPOUNDS	T O X I C I T Y	G R O U P	DISTRIBUTION				ONTARIO SPILLS 1975-79	D I S T R I B . G R O U P	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)			TOTAL				
			DOMESTIC ORIGIN	IMPORTS						
AMMONIUM HYDROXIDE	III			335,000	335,000	5	A		Accept	
AMMONIUM NITRATES	X	S	1,164,000	23,341	1,187,341		A		Reject	
AMMONIUM OXALATE	X									
AMMONIUM PHOSPHATES	X	S	1,610,000	336,000	3,556,000		A		Reject	
AMMONIUM PICRATE	X									
AMMONIUM SILICOFLUORIDE	I									
AMMONIUM SULPHATES	X	S	235,000	14,782	249,782		A		Reject	
AMMONIUM SULPHIDE	II			1,266	1,266	1	D		Reject	
AMMONIUM SULPHITE	X									
AMMONIUM THIOCYANATE	X			83	83		X		Reject	
AMMONIUM THIOSULPHATE	X			1,089	1,089		C		Reject	
n-AMYL ALCOHOL	II			526	526		C		Accept	
AMYL CHLORIDE	I									
ANILINE	II			679	679		C		Accept	
ANILINE SULPHATE	X									
ARSENIC	X			28	28		X		Reject	

COMPOUNDS	TOXICITY	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
ARSENIC ACID	II		37	37		X		Reject
ARSENIC TRICHLORIDE	I					X		
ARSENIC TRIOXIDE	I		93	93		X		Reject
AZINPHOS-METHYL (GUTHION)	II	U 25		25		X		Reject
BARIUM OXALATE	X							
BENZENE	II	S 675,000	12,750	687,750		A		Accept
BENEZENE SULPHONIC ACID	X		88	88		X		Reject
BENZOIC ACID	X	S 43,000	41	43,041		B		Reject
78								
BENZOYL CHLORIDE	II		209	209		X		Reject
BENZOYL HYDRAZINE	X							
BENZOYL PEROXIDE	II		218	218		X		Reject
BENZYL ACETATE	I		21	21		X		Reject
BENZYL ALCOHOL	II		297	297		X		Reject
BENZYL CHLORIDE	I		48	48		X		Reject
BERYLLIUM FLUORIDE	X							
BORON TRIBROMIDE	I							

COMPOUNDS	TOXICITY	DISTRIBUTION	QUANTITIES (m tons)			ONTARIO SPILLS 1975-79	DISTRIBUTION	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)						
			DOMESTIC ORIGIN	IMPORTS	TOTAL				
BORON TRICHLORIDE	II								
BORON TRIFLUORIDE	II		17	17			X		Reject
BROMACIL	X								
BROMINE	I		1,394	1,394			A		Accept
BROMOTRIFLUOROMETHANE	III		171	171			X		Reject
BUTADIENE	X	P 546,486	35,500	581,986			A		Reject
BUTANE	X	E 631,241	9,417	640,658	1		A		Reject
n-BUTYL ACRYLATE	I		6,542	6,542			B		Accept
n-BUTYL ALCOHOL	III	S 10,000	500	10,500			B		Reject
BUTYLATED HYDROXYTOLUENE	X			205			X		Reject
t-BUTYL HYDROPEROXIDE	II				1		D		Reject
BUTYL LITHIUM	III								
BUTYL MAGNESIUM CHLORIDE	X								
p-tert-BUTYL PHENOL	X								
n-BUTYRALDEHYDE	X	S 75,000	300	75,300					Reject
CADMIUM BENZOATE	X								

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
CADMIUM CYANIDE	X							
CADMIUM NITRATE	X							
CADMIUM OXIDE	X							
CADMIUM SELENIDES	X							
CADMIUM SULPHATE	X							
CADMIUM SULPHIDES	X							
CADMIUM SULPHOSELENIDE	X							
CALCIUM CYANIDE	II	E 426		426	1	D	HCN released slowly with water	Reject
CALCIUM FLUORIDE	X							
CALCIUM HYPOCHLORITE	X	S 300	3,709	4,009	1	C		Reject
CALCIUM IODIDE	X							
CALCIUM ISODECANOATE	X							
CALCIUM NAPHTHENATE	X							
CALCIUM PHOSPHATES	X	S 260,000	39,700	299,700	1	A		Reject
CALCIUM PLUMBATE	X							
CALCIUM SULPHATE	X		70	70		X		Reject

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
CAPROLACTAM	I		9,929	9,929		B		Accept
CARBARYL (SEVIN)	I		26	26		X		Reject
CARBOFURAN	X		4,030	4,030		C		Reject
CARBON DISULPHIDE	II		107	107		A*		Accept
CARBON MONOXIDE	III							
CARBON TETRACHLORIDE	II	P 27,000	1,084	28,084		B		Accept
CARBONYL CHLORIDE (PHOSGENE)	I							
CHLORAMPHENICOL	X		24	24		X		Reject
CHLORDANE	X	s 161		161		X		Reject
CHLORINE	I	P1,034,239	904,500	1,938,739	2	A		Accept
CHLORINE DIOXIDE	I							
CHLOROACETIC ACID	X		173	173		X		Reject
CHLOROANILINE	X				1	D		Reject
CHLOROBENZENE	I		19	19		X		Reject
CHLOROBUTANE	I							
CHLOROFLUOROETHANE	X		250	250		X		Reject

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
CHLOROFORM	II	S 50	5,620	5,670	B		Accept	
2-CHLORO-4-PHENYL PHENOL	X							
CHLOROSULPHONIC ACID	I		1,585	1,585	C	toxic agents are SOx and ClSO3H	Accept	
CHROMIC ACID(CHROMIC TRIOXIDE)	X		1,300	1,300	C		Reject	
COAL TAR, CRUDE	X	E 20,370 U 150,473		170,843	A		Reject	
COBALTOUS NAPHTHENATE	X							
COPPER CYANIDE	II		118	118	X		Reject	
COPPER NAPHTHENATE	X							
CREOSOTE	X							
CRESOLS (CRESYLIC ACIDS)	II		1,514	1,514	C		Accept	
CUMENE (ISOPROPYL BENZENE)	X	S 39,500		39,500	A		Reject	
CUMENE HYDROPEROXIDE	I		140	140	X		Reject	
CYANOGEN IODIDE	III							
CYANOPYRIDINE	I					toxic agents are HCN & C6H4N2		
CYCLOHEXANE	III	S 113,500	108	11,368	B		Reject	
CYCLOHEXANOL	X		27	27	X		Reject	

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
CYCLOHEXANONE	X		348	348		X		Reject
CYCLOHEXYLAMINE	I		632	632		C		Accept
CYCLOPENTANE	X							
CYCLOPENTANONE	X							
DDT	X							
DECABORANE	I							
DEHYDROABIETYLAMINES	X							
1,2-DIAMINOCYCLOHEXANE	III							
DIAZINON	I		156	156		X		Reject
DIBENZOTHAZYL DISULPHIDE	X		236	236		X		Reject
DIBORANE	I							
DIBROMOMETHANE (METHYLENE DIBROMIDE)	X							
DIBUTYL TIN DILAUATE	X							
1,2-DICHLOROBENZENE	X		100	100		X		Reject
1,4-DICHLOROBENZENE	II		4,530	4,530		C		Accept

COMPOUNDS	T O X I C I T Y	G R O U P	DISTRIBUTION			ONTARIO SPILLS 1975-79	D I S T R I B . G R O U P	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)						
			DOMESTIC ORIGIN	IMPORTS	TOTAL				
DICHLORODIFLUOROMETHANE (FREON 12)	X		339	339		X		Reject	
DICHLOROMETHANE (METHYLENE DICHLORIDE)	III					A		Accept	
2,4-DICHLOROPHENOL	X								
2,4-D(DICHLOROPHENOXYACETIC ACID)	II	s	3,407	1,100	4,507	1	C	Accept	
1,3-DICHLOROPROPENE	II								
2,3-DICHLOROPROPENE	II								
DICHLOROTETRAFLUROETHANE	X								
DICYANDIAMIDE(CYANOQUANIDINE)	X								
DIELDRIN	X						X		
DIETHYL AMINE	III								
DIETHYL ANILINE	X								
DIETHYL ETHER	X			874	874		C	Reject	
DIETHYL SULPHATE	II								
DIISOBUTYLENE	II			71	71		A*	Accept	
DIISOBUTYL KETONE	X			113	113		X	Reject	
DIISOPROPANOLAMINE	X								

COMPOUNDS	T O X I C I T Y G R O U P	DISTRIBUTION				ONTARIO SPILLS 1975-79	D I S T R I B . G R O U P	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)			TOTAL				
		DOMESTIC ORIGIN	IMPORTS						
DIMETHOATE	II		23	23		X		Reject	
DIMETHYLAMINE	III		2,205	2,205		C		Reject	
DIMETHYL ETHER	II								
n,n-DIMETHYLFORMAMIDE	X		140	140		X		Reject	
DIMETHYL SULPHATE	I		290	290		X		Reject	
DIMETHYL SULPHIDE	II								
DIMETHYL SULPHOXIDE	X								
DINITRO-O-SEC. BUTYL PHENOL	X								
2,4-DINITROTOLUENE (DNT)	I		158	158		X		Reject	
DIOCTYL SODIUM SULPHOSUCCINATE	X								
1,4-DIOXANE	II		244	244		X		Reject	
DIPHENYL	I								
DIPHENYLAMINE	I		2,786	2,786		C		Accept	
DIPHENYL METHANE 4,4-DIISOCYANATE	I		671	671		C		Accept	
DIPHENYLMERCURY DODECENYL SUCCINATE	X								
n,n-DIPHENYL-PARA-PHENYLENEDIAMINE	X								

COMPOUNDS	TOXICITY	DISTRIBUTION				ONTARIO SPILLS 1975-79	DISTRIBUTION	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)			TOTAL				
		DOMESTIC ORIGIN	IMPORTS						
DIQUAT	II		415	415		X		Reject	
DIVINYLBENZENE	I		114	114		X		Reject	
DODECYL MERCAPTAN	X		150	150		X		Reject	
PARA-DODECYLPHENOL	X								
DODINE (CYPREX)	X								
ENDRIN	X								
EPICHLOROHYDRIN	I		2,651	2,651		C	in fire, toxic agent may be COCl ₂ , C ₃ H ₅ OC1	Accept	
EPOXY RESINS	X	S 6,000	6,452	12,452		B		Reject	
ETHYL ACETATE	III	S 1,000	5,711	6,711		B		Reject	
ETHYL ACRYLATE	III		6,734	6,734		B		Reject	
ETHYLBENZENE	III	S 340,500		340,500		A		Accept	
ETHYL BUTYRALDEHYDE	X								
ETHYL CHLORIDE	I	P 31,500	2,029	33,529		B	toxic agent in fire is COCl ₂	Accept	
ETHYLENE	X	P1,073,986	529	1,074,515		A		Reject	
ETHYLENE DIAMINE	III		283	283		X		Reject	
ETHYLENE DIBROMIDE	II		7,005	7,005		B		Accept	

COMPOUNDS	T O X I C I T Y	G R O U P	DISTRIBUTION			ONTARIO SPILLS 1975-79	D I S T R I B . G R O U P	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)						
			DOMESTIC ORIGIN	IMPORTS	TOTAL				
ETHYLENE DICHLORIDE	I	I	S 145,500	2,107	147,607	1	A	in fire toxic agents are COCl ₂ , HCl, C ₂ H ₄ Cl ₂	Accept
ETHYLENE GLYCOL	X	X	S 106,000	10,697	116,697		A		Reject
ETHYLENE GLYCOL DINITRATE	II	II							
ETHYLENE GLYCOL MONOETHYL ETHERS	X	X		1,728	1,728		C		Reject
ETHYLENE GLYCOL MONOETHYL ETHER ACETATE	III	III		3,380	3,380		C		Reject
ETHYLENE GLYCOL MONOMETHYL ETHERS	II	II		75			X		Reject
ETHYLENEIMINE	I	I							
ETHYLENE OXIDE	II	II	S 118,000	300	118,300		A		Accept
ETHYL MERCAPTAN	II	II							
ETHYL METHACRYLATE	X	X		348	348		X		Reject
FENTANYL CITRATE	X	X							
FERRIC CHLORIDE	X	X		15,710	15,710	3	B		Reject
FERROUS SULPHIDE	X	X		9,141	9,141		X		Reject
FERROSILICON	X	X	E 44,899	19,840	64,739		X		Reject
FERROUS PHOSPHIDE	II	II						toxic agent is PH ₃	
FLUOBORIC ACID	X	X							

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION				ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)			TOTAL				
		DOMESTIC ORIGIN	IMPORTS						
FLUORINE	I		7	7		X		Reject	
FLUOSILICIC ACID	X	U 2,956		2,956		C		Reject	
FORMALDEHYDE (COMMERCIAL SOLUTION)	II	P 141,630	7,313	148,943		A		Accept	
FORMAMIDE	II								
FORMIC ACID	II		683	683		C		Accept	
FURFURYL ALCOHOL	II		1,167	1,167		C		Accept	
GANGLIOSIDE	X								
GLYOXAL	X		1,073	1,073		C		Reject	
HEPTACHLOR	I					X		Reject	
HEPTANE	III		141	141		X		Reject	
HEXAMETHYLENEDIAMINE	II		1,772	1,772		C		Accept	
HEXAMETHYLENEIMINE	I								
HEXAMETHYLENETETRAMINE (HEXAMINE)	X	U 91 E 580		671		C		Reject	
HYDRAZINE	II		20	20		X		Reject	
HYDROCHLORIC ACID	III	P 154,097	23,293	117,390	9	A		Accept	
HYDROFLUORIC ACID	I	E 31,000	1,927	32,927	1	B		Accept	

COMPOUNDS	T O X I C I T Y	G R O U P	DISTRIBUTION			ONTARIO SPILLS 1975-79	D I S T R I B .	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)						
			DOMESTIC ORIGIN	IMPORTS	TOTAL				
HYDROGEN CHLORIDE (ANHYDROUS)	II	S	154,600	3,700	158,300		A		Accept
HYDROGEN FLUORIDE	I		78,500	1,400	49,900		B		Accept
HYDROGEN PEROXIDE	II			4,800	4,800		C		Accept
HYDROGEN SULPHIDE	I			2,478	2,478	2	D		Accept
HYDROQUINONE	X			94	94		X		Reject
2-HYDROXY METHYL-2-NITRO-1,3-PROPANEDIOL	X								
HYPHOPHOSPHORUS ACID	X			5	5		X		Reject
IODINE	I			260	260		X		Reject
ISOAMYL ALCOHOL	III			1,051	1,051		C		Reject
ISOBUTANOL	III	E	469	764	1,233		C		Reject
ISOBUTYLENE	X	U	55,000		55,000		A		Reject
ISOBUTYL METHYL KETONE(MIBK)	III	S	7,500	389	7,889		X		Reject
ISOPHORONE	II			284	284		X		Reject
ISOPRENE	X			1,585	1,585		C		Reject
ISOPROPYL ETHER	III								
LEAD COMPOUNDS	X								

COMPOUNDS	T O X I C I T Y G R O U P	DISTRIBUTION				ONTARIO SPILLS 1975-79	D I S T R I B . G R O U P	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)							
		DOMESTIC ORIGIN	IMPORTS	TOTAL					
LIME (CALCIUM OXIDE)	II	S 914,624		914,614	7	A		Accept	
LINDANE	X		473	473		X		Reject	
MAGNESIUM FLUORIDE	X								
MALATHION	X	s 460	439	899		C		Reject	
MALEIC ACID	X								
MALEIC ANHYDRIDE	I	S 4,300	1,200	5,500		B		Accept	
MALEIC HYDRAZIDE	X								
MELAMINE	X	E 197	3,913	4,110		C		Reject	
90									
MERCURIC NITRATE	I								
MERCUROUS NITRATE	X								
MERCURY	I		51	51		X		Reject	
MESITYL OXIDE	X								
METHACRYLIC ACID	II								
METHOXYCHLOR (DMDT)	X	s 31		31		X		Reject	
METHYL ACETATE	III		7	7		x		Reject	
METHYL ACRYLATE	II		1,100	1,100		C		Accept	

COMPOUNDS	T O X I C I T Y	DISTRIBUTION			ONTARIO SPILLS 1975-79	D I S T R I B .	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
METHYLAMINE	I		2,365	2,365		C	toxic agents are NO _x and CH ₃ NH ₂	Accept
METHYLAMYL ACETATE	X							
METHYL BROMIDE	I		28	28		X		Reject
METHYL CHLORIDE	I	S 300	3,545	3,845		C		Accept
METHYL CHLOROPHENOXYACETIC ACID	X	s 1481	1,170	2,651		C		Reject
METHYLENE DIANILINE	III							
METHYLENE IODIDE	I							
METHYL ETHYL KETONE	III		6,651	6,651		B		Reject
METHYL ETHYL KETONE PEROXIDE	I		246	246		X		Reject
METHYL ETHYL PYRIDINE	X							
METHYL IODIDE	II							
METHYL ISOBUTYL CARBINOL	X	S 3,900		3,900		C	in fire toxic agents are SO _x and CH ₃ SH	Reject
METHYL MERCAPTAN	II							
METHYL METHACRYLATE	III		18,911	18,911		B		Reject
METHYL PARATHION	X							
METHYL PROPYL BENZENE(CYME NE)	X							

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
METHYL - P - TOLUENESULPHONATE	X							
MOLYBDENUM TRIOXIDE	I		336	336		X		Reject
MONOCHLORODIFLUOROMETHANE	X							
MONOETHANOLAMINE	I		606	606		B*		Accept
MONOSODIUM METHANE ARSONATE (MSMA)	X							
MORPHOLINE	I		598	598		C	toxic agent is NOx	Accept
NAPHTHA	III	P 328,540	20,207	348,747		A		Accept
NAPHTHALENE	II		1,273	1,273		C		Accept
2-NAPHTHOL	X		375	375		X		Reject
NICKEL CARBONYL	I							
NITRIC ACID	II	P 612,186	1,218	613,404	3	A		Accept
NITROBENZENE	II							
NITROGEN DIOXIDE	I							
NITROHYDROCHLORIC ACID	I							
n-NITROSODIPHENYLAMINE	X							
NITROUS OXIDE	III		257	257		X		Reject

*Additional information supplied by Department of Industry, Trade and Commerce (January 30, 1981)

COMPOUNDS	TOXICITY	GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)						
			DOMESTIC ORIGIN	IMPORTS	TOTAL				
NONYL PHENOL	X		4,500	1,000	5,500		B		Reject
OCTYL PHENOL	II								
OXALIC ACID	II			1,060	1,010		C		Accept
PARAFORMALDEHYDE	II			1,533	1,533		C		Accept
PARAQUAT	X			289	289	2	X		Reject
PARATHION	I			17	17		X		Reject
PENTABORANE	I								
PENTACHLOROETHANE	I								
PENTACHLOROPHENOL	I			625	625		C		Accept
PERCHLOROETHYLENE	II			909	15,409		B		Accept
o-PHENETIDINE	I								
PHENOL (CARBOLIC ACID)	II		S 54,000	9,503	63,503		A		Accept
PHENYLMERCURIC ACETATE	X								
PHENYLMERCURIC OLEATE	I								
PHOSPHINE OXIDE(MAPO-METEPA)									
PHOSPHORIC ACID	I		P 732,603	10,000	742,603	1	A		Accept

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION				ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)			TOTAL				
		DOMESTIC ORIGIN	IMPORTS						
PHOSPHORUS PENTACHLORIDE	II		20		20	X		Reject	
PHOSPHORUS PENTASULPHIDE	II								
PHOSPHORUS PENTOXIDE	I		103		103	X		Reject	
PHOSPHORUS PYRIDIDE									
PHOSPHORUS SESQUISULPHIDE	II								
PHOSPHORUS TRICHLORIDE	I		138		138	X		Reject	
PHOSPHORUS, YELLOW	I	S 73,000	1,461		74,461	A	toxic agents include PO _x	Accept	
PHTHALIC ANHYDRIDE	X	P 38,250	900		39,150	B		Reject	
PIPERAZINE	X		115		115	X		Reject	
POLYCHLORINATED BIPHENYLS (PCB)	II					D		Accept	
POLYPHOSPHORIC ACID	X		8,610		8,610	B		Reject	
POTASSIUM	X	S 234,232			234,232	A		Reject	
POTASSIUM BROMATE	X								
POTASSIUM CHLORATE	X		416		416	X		Reject	
POTASSIUM CHLOROPLATINATE	X								
POTASSIUM COPPER CYANIDE	II								

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION GROUP	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
POTASSIUM CYANIDE	I		145	145		X		Reject
POTASSIUM DICHROMATE	X		50	50		X		Reject
POTASSIUM FERROCYANIDE	X							
POTASSIUM FLUORIDE	X		240	240		X		
POTASSIUM HYDROXIDE	X	S 7,500	3,856	11,356	4	B		Reject
POTASSIUM IODIDE	X							
POTASSIUM OXALATE	X							
POTASSIUM SULPHATE	X	S 1,115	20,107	21,222		B		Reject
POTASSIUM THIOCYANATE	X							
1-PROPANETHIOL	II							
PROPIONALDEHYDE	III							
n-PROPYL ALCOHOL	III	P 83,028	2,607	85,635		A		Accept
PROPYLENE DICHLORIDE	III							
PROPYLENE GLYCOL ACETATE	X							
PROPYLENE OXIDE	III	S 50,500	100	50,600	1	A		Accept
PYRIDINE	I		62	62		X		Reject

COMPOUNDS	T O X I C I T Y	DISTRIBUTION			ONTARIO SPILLS 1975-79	D I S T R I B .	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
2-PYRROLIDONE	X		116	116		X		Reject
QUINOLINE	X							
SILICA (SILICON DIOXIDE)	X	E 14,159	10,501	24,660		B		Reject
SILICON TETRACHLORIDE	II							
SILVER CYANIDE	I							
SODIUM	X		8,237	8,237		B		Reject
SODIUM ARSENITE	I							
SODIUM BENZENE SULPHONATE	X							
96								
SODIUM BISULPHITE	X		9,451	9,451		B		Reject
SODIUM BORATE	X		59,236	59,236		A		Reject
SODIUM BOROHYDRIDE	X		116	116		X		Reject
SODIUM BROMIDE	X							
SODIUM CHLORATE	X	P 232,765	2,065	234,830		A		Reject
SODIUM CHLORITE	X		192	192		X		Reject
SODIUM CHLOROPLATINATE	II							
SODIUM COPPER CYANIDE	II							

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
SODIUM CYANIDE	I	S 2,500	4,577	7,077		B		Accept
SODIUM DICHROMATE	X		7,603	7,603		B		Reject
SODIUM DIETHYLDITHIOCARBAMATE	X							
SODIUM DODECYLBENZENESULPHONATE	X							
SODIUM FLUORIDE	X		455	455		X		Reject
SODIUM HYDROGEN SULPHIDE	X	P 25,000	3,371	28,371		B		Reject
SODIUM HYDROXIDE	X	P1,139,712	349,000	1,488,712	1	A		Reject
SODIUM HYPOCHLORITE	X	S 150,500	571	151,071	1	A		Reject
SODIUM HYPOPHOSPHITE	X							
SODIUM LAURYL SULPHATES	X							
SODIUM NITRATE	X	U 20,232		20,232		B		Reject
SODIUM OXALATE	X							
SODIUM OXIDE	X							
SODIUM PEROXIDE	X		32	32		X		Reject
SODIUM PHENOLATE	X							
SODIUM PHOSPHATES	X	S 42,500	55,000	97,500		A		Reject

COMPOUNDS	TOXICITY	GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)						
			DOMESTIC ORIGIN	IMPORTS	TOTAL				
SODIUM PRUSSIATES	X								
SODIUM SELENATE	X								
SODIUM SELENITE	X	E 2			2		X		Reject
SODIUM STANNATE	X			5	5		X		Reject
SODIUM SULPHANETHAZINE									
SODIUM SULPHATE	X	S 538,000		25,200	563,200		A		Reject
SODIUM SULPHIDE	X			885	885		X		Reject
SODIUM SULPHITE	III			6,799	6,799		B		Reject
SODIUM THIOSULPHATE	X			2,136	2,136		C		Reject
SODIUM TOLUENE SULPHONATE	X								
SODIUM TRIDECYL SULPHONATES	X								
STANNOUS FLUORIDE	II			30	30		X		Reject
STANNOUS SULPHATE	X			17	17		X		Reject
STRONTIUM CHROMATE	X	E 281			281		X		Reject
STRONTIUM NITRATE	X								
STYRENE	III	S 285,000		812	285,812	4	A		Accept

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
SULPHAMIC ACID	X		1,113	1,113		C		Reject
SULPHUR	X	\$5,868,000	8,100	5,876,100	2	A		Reject
SULPHUR DIOXIDE	II	112,000	6,233	118,233		A		Accept
SULPHUR MONOCHLORIDE	I		660	660		C	toxic agent in moist air include HCl & S ₂ Cl ₄	Accept
SULPHUR TRICHLORIDE	I							
SULPHUR TRIOXIDE	I							
SULPHURIC ACID	II	\$3,685,919	170,621	3,856,540	12	A		Accept
SULPHUROUS ACID	II							
TETRABROMOETHANE	X							
TETRACHLOROETHANE	II		228	228		X		Reject
TETRACHLOROPHENOL	X							
TETRAETHYLLEAD	I		21,000	21,000		B		Accept
TETRAETHYLTHIURAM DISULPHIDE	X							
TETRAHYDROFURAN	X		542	542		C		Reject
TETRAHYDRONAPHTHALENE	II							
TETRAMETHYLLEAD	I					C*		Accept

COMPOUNDS	T O X I C I T Y	D I S T R I B .	DISTRIBUTION			ONTARIO SPILLS 1975-79	D I S T R I B .	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)						
			DOMESTIC ORIGIN	IMPORTS	TOTAL				
TETRAMETHYLTHIURAM DISULPHIDE	X			352	352		X		Reject
TETRAMETHYLTHIURAM MONOSULPHIDE	X			69	69		X		Reject
THIOGLYCOLIC ACID	III			120	120	1	X		Reject
THIOUREA	X			163	163		X		Reject
TITANIUM TETRACHLORIDE	I			1,550	1,550		C	toxic agent in moist air includes HCl	Accept
TOLUENE	III		P 643,104	19,786	662,890	1	A		Accept
TOLUENE 2,4-DIISOCYANATE	I		S 4,000	9,500	13,500		B		Accept
P-TOLUENE SULPHONIC ACID	X								
o-TOLUIDINE	II			10	10		X		Reject
TOXAPHENE	I						X		
TRIBUTOXYETHYL PHOSPHATE	X			225	225		X		Reject
TRI-n-BUTYL BORATE	X						X		
TRI-BUTYL PHOSPHATE	III			112	112		X		Reject
TRIBUTYL PHOSPHINE	X								
1,2,4-TRICHLOROBENZENE	I			146	146		X		Reject
1,1,1-TRICHLOROETHANE	II		S 12,500	2,432	13,310		B		Accept

COMPOUNDS	TOXICITY GROUP	DISTRIBUTION			ONTARIO SPILLS 1975-79	DISTRIBUTION	COMMENTS	ACCEPT OR REJECT
		QUANTITIES (m tons)						
		DOMESTIC ORIGIN	IMPORTS	TOTAL				
TRICHLOROETHYLENE	II	S 12,750	560	13,310	B		Accept	
TRICHLOROISOCYANURIC ACID	I		472	472	X		Reject	
2,4,5-TRICHLOROFLUOROMETHANE	III							
2,4,5-TRICHLOROPHENOXACETIC ACID	X	s 51	330	381	X		Reject	
TRICHLOROTRIFLUOROETHANE	III		<250	<250	X		Reject	
TRICRESYL PHOSPHATES	I		125	125	X		Reject	
TRIDECYL BENZENE SULPHONIC ACID	X							
TRIETHANOLAMINE	X		217	217			Reject	
TRIETHANOLAMINE DODECYL BENZENE SULPHONATE	X							
TRIETHANOLAMINE OLEATE	X							
TRIETHANOLAMINE STEARATE	X							
TRIETHYLAMINE	II		135	135	X		Reject	
TRIFLURALIN	X		12,757	12,757	2	B	Reject	
TRIMETHYLAMINE	X	E 467	82	549		C	Reject	
1,2,4-TRIMETHYL BENZENE	II							
2,2,4-TRIMETHYLPENTANE (ISOOCTANE)	II		26	26		X	Reject	

COMPOUNDS	T O X I C I T Y	T O X I C I T Y	DISTRIBUTION			ONTARIO SPILLS 1975-79	D I S T R I B .	COMMENTS	ACCEPT OR REJECT
			QUANTITIES (m tons)						
			DOMESTIC ORIGIN	IMPORTS	TOTAL				
TRIPHENYL PHOSPHITE	X								
TRIPROPYL TIN METHACRYLATE	X								
TURPENTINE	X	S 10,000	900	10,900		B		Reject	
VALERALDEHYDE	X								
VANADIUM NAPHTHENATE	X								
VANADIUM PENTOXIDE	I		1,006	1,006		C		Accept	
VINYL ACETATE MONOMER	I		19,600	19,600	1	B	combustion products are COCl ₂ , HCl & CO	Accept	
VINYL CHLORIDE MONOMER	I	S 88,000	78,026	166,026		A		Accept	
VINYLDENE CHLORIDE	I						combustion products include COCl ₂ & HCl		
VINYL TOLUENE	X		340	340		X		Reject	
XYLENES	III	P 393,036	16,790	409,826	1	A		Accept	
O-XYLENOL	II		120	120		X		Reject	
ZINC ACETATE	X								
ZINC CHLORIDE	X		1,491	1,491		C		Reject	
ZINC CHROMATE	X	U 444		444		X		Reject	
ZINC CYANIDE	X								

APPENDIX 4

CHEMICAL COMMODITY PROFILES

A profile of the manufacturers, distributors and major buyers is provided for each of the commodity chemicals. The sources used (Canadian Chemical Association, 1979¹; FI Trade & Finance²; Chemical Export Data, 1980³), provided information regarding manufacturers and distributors. Only limited data of information was found pertaining to the various buyers in transportation for each chemical, e.g. rail, road or ship, and these are not included.

Where these profiles are available they are included in the commodity profiles. The chemicals that are manufactured for negative use only, are omitted.

APPENDIX 4

CHEMICAL COMMODITY PROFILES

APPENDIX 4

CHEMICAL COMMODITY PROFILES

A profile of the manufacturers, distributors and major buyers is reported for the 79 priority chemicals. The sources used (Canadian Chemical Register, 1978³; CPI Product Profiles⁴⁶; Chemical Buyers Guide, 1980⁴⁷), provided information regarding manufacturers and distributors. Only isolated items of information were found pertaining to the various modes of transportation for each chemical, e.g. rail, road or ship, and these are not included.

Since these profiles are ultimately designed to show the transportation patterns, the chemicals that are manufactured for captive use only, are omitted.

ACETIC ACID

Manufacturers: Caledon Laboratories Ltd., Georgetown
(also manufactured in Edmonton, Alberta)

Distributors: None listed

Major Users: Signal Chemicals, Toronto
Allied Chemical Canada,
Thunder Bay Plant, Thunder Bay
Nellie Lake Plant, Iroquois Falls
Thorold Plant, Thorold

ACETIC ANHYDRIDE

Manufacturers: Only manufactured in Alberta
Celanese Canada Inc., Edmonton, Alberta

Distributors: None listed

Major Users: A & K Petro-Chem Industries Ltd., Weston
Anachemia Solvent Ltd., Mississauga

ACETONITRILE

Manufacturers: Caledon Laboratories Ltd., Georgetown
(sole manufacturers in Canada)

Distributors: Monsanto Canada Inc., Mississauga
(imported from U.S.A.)

Major Users Polysar Ltd., Sarnia

ACRYLAMIDE

Manufacturers: Not manufactured in Canada

Distributors: Dow Chemical of Canada Ltd., Sarnia
(imported from U.S.A.)

Major Users: Dow Chemical of Canada Ltd., Sarnia

ACRYLONITRILE

Manufacturers: Not manufactured in Canada

Distributors: Borg-Warner (Canada) Ltd., Plastics
Division, Cobourg
DuPont of Canada Ltd., Maitland
Monsanto Canada Inc., Sarnia
Polysar Ltd., Sarnia
(imported from U.S.A. Belgium)

Major Users: As above

ALUMINUM CHLORIDE (ANYDROUS)

Manufacturers: Welland Chemical of Canada Ltd., Sarnia
(sole manufacturer in Canada)

Distributors: None listed

Major Users: A & K Petro-Chem Industries Ltd., Weston

AMMONIA (ANHYDROUS)

Manufacturers: C.I.L., Courtright
Cyanamid of Canada Ltd., Niagara Falls
Genstar Chemical Ltd., Maitland
Steel Co. of Canada Ltd., Hamilton
(also manufactured in Calgary, Redwater,
Fort Saskatchewan and Medicine Hat, Alberta
and Trail, B.C.)

Distributors: Genstar Chemical Ltd., Montreal
United Co-operatives of Ontario, Mississauga
(imported from U.S.A. and Venezuela)

Major Users: Agricultural Chemicals Ltd., London
Chinook Chemicals Ltd., Sombra
Dow Chemicals of Canada Ltd., Sarnia
DuPont of Canada Ltd., Maitland
Genstar Chemical Ltd., Maitland
INCO Metals Co., Copper Cliff
Matheson of Canada Ltd., Whitby
United Co-operatives of Ontario, Mississauga

AMMONIUM HYDROXIDE

Manufacturers: Cyanamid of Canada Ltd., Niagara Falls
Genstar Chemical Ltd., Maitland
Dustbane Enterprises, Ottawa

Distributors: None listed

Major Users: Allied Chemical Canada Ltd., Toronto
Canadian Hanson Ltd., Toronto

n-AMYL ALCOHOL

Manufacturers: Caledon Laboratories Ltd., Georgetown
(sole manufacturer in Canada)

Distributors: None listed

Major Users: Dominion Cisco Ltd., Hamilton
Union Carbide Canada Ltd., Toronto

ANILINE

Manufacturers: Not manufactured in Canada

Distributors: Uniroyal Chemical, Elmira
(imported from U.S.A.)

Major Users: Uniroyal Chemical, Elmira

BENZENE

Manufacturers: Caledon Laboratories Ltd., Georgetown
Esso Chemical Canada, Sarnia
Petrosar Ltd., Corunna
Shell Canada Ltd., Corunna
Sunchem, Division of Sunoco Inc., Sarnia
Texaco Canada Ltd., Mississauga
(also manufactured in Pointe-Aux-Trembles,
Quebec)

Distributors: U.S. Steel International Ltd., Toronto
(imported from U.S.A.)

Major Users: Ashland Chemicals/Solvents, Toronto
Dow Chemical of Canada Ltd., Sarnia
Polysar Ltd., Sarnia
U.S. Steel International Ltd., Toronto

BROMINE

Manufacturers: Not manufactured in Canada
Distributors: Dow Chemical of Canada Ltd., Sarnia
(imported from U.S.A.)
Major Users: Dow Chemical of Canada Ltd., Sarnia
Velsicol Corp. of Canada Ltd., Mississauga

n-BUTYL ACRYLATE

Manufacturers: Not manufactured in Canada
Distributor: Rohm and Haas Canada Ltd., West Hill
(imported from U.S.A.)
Major Users: Rohm and Haas Canada Ltd., West Hill
Celanese Canada, Toronto
CPS Chemical Canada Ltd., Toronto

CALCIUM OXIDE

Manufacturers: Domtar Inc., Chemicals Group, Beachville
The Steel Co. of Canada Ltd., Chemical-
Lime Works, Ingersoll
Distributors: None listed
Major Users: As above

CAPROLACTAM

Manufacturers: Badische Canada Ltd., Arnprior
(re-refined) (sole manufacturers in
Canada)
Distributors: None listed
Major Users: None listed

CARBON DISULPHIDE

Manufacturers: Cornwall Chemicals Ltd., Cornwall
(also manufactured in Fort Saskatchewan,
Alberta)

Distributors: No longer imported from U.S.A. since
1979

Major Users: BCL Canada Ltd., Cornwall
Courtlands Canada Ltd., Cornwall
Cyanamid of Canada Ltd., Niagara Falls
Union Carbide Canada, Lindsay
Uniroyal Chemical, Elmira

CARBON TETRACHLORIDE

Manufacturers: Caledon Laboratories Ltd., Georgetown
Cornwall Chemicals Ltd., Cornwall
Dow Chemical of Canada Ltd., Sarnia
(only manufacturers in Canada)

Distributors: Dow Chemical of Canada Ltd., Sarnia
(imported from U.S.A.)

Major Users: Allied Chemical Ltd., Amherstburg
Bate Chemical Co. Ltd., Don Mills
Canada Colours and Chemicals Ltd., Toronto
DuPont of Canada Ltd., Maitland
Harrisons and Crosfield (Canada) Ltd.,
Toronto
International Chemical Canada Ltd.,
Brampton

CHLORINE

Manufacturers: C.I.L., Cornwall
Dow Chemical of Canada Ltd., Sarnia
Reed Ltd., Chemical Division, Dryden
Welland Chemical Ltd., Mississauga
Welland Chemical Ltd., Sarnia
(also manufactured in Becancour, Shawinigan,
Beauharnois, Quebec; Dalhousie, New
Brunswick; Abercrombie Point, Nova Scotia;
Brandon, Manitoba; Saskatoon, Saskatchewan;
Fort Saskatchewan, Alberta; Nanaimo,
North Vancouver, Squamish, British Columbia)

Distributors: Distributed in Alberta and British Columbia,
as an import from U.S.A.

Major Users: Abitibi-Price, Smooth Rock Falls
American Canada Ltd., Marathon
Bartek Chemical, Burlington
Bristol-Myers, Toronto
Canadian International Paper, Hawkesbury
Chlorox Ltd., Bramalea
Cornwall Chemicals Ltd., Cornwall
Diversey Canada Ltd., Mississauga
Domtar Inc., Cornwall
Eddy Forest Products, Espanola
Ethyl Canada Ltd., Sarnia
Great Lakes Forest Products, Thunder Bay
International Chemical Ltd., Brampton
Kimberly-Clarke, Terrace Bay
Matheson of Canada Ltd., Brampton
Toronto Metro (for sanitation)

CHLOROFORM

Manufacturers: Not manufactured in Canada

Distributors: Allied Chemical Ltd., Mississauga
Dow Chemical of Canada Ltd., Sarnia
Harrisons and Crosfield Ltd., Toronto
(imported from U.S.A., France, Netherlands
and West Germany)

Major Users: Allied Chemical Ltd., Amherstburg
Canadian Scientific Products Ltd., London
DuPont of Canada Ltd., Maitland
International Chemicals Ltd., Brampton
Parker and Davis Ltd., Toronto

CHLOROSULPHONIC ACID

Manufacturers: Not manufactured in Canada

Distributors: DuPont of Canada Ltd., Toronto
Monsanto Canada Inc., Mississauga
(imported from U.S.A.)

Major Users: Bayer (Canada) Inc., Mississauga

CRESOLS (CRESLYIC ACIDS)

Manufacturers: Not manufactured in Canada

Distributors: Domtar Chemicals Group, Tar and Chemicals
Division, Toronto

Major Users: Apco Industries Co. Ltd., Toronto
Bate Chemicals Co. Ltd., Don Mills
Bayer (Canada) Inc., Mississauga
Dominion Cisco Industries Ltd, Weston
Domtar Chemical Group, Mississauga
Minerals and Chemicals Ltd., Toronto
Tennant Charles and Co. (Canada) Ltd.,
Weston

CYCLOHEXYLAMINE

Manufacturers: Not manufactured in Canada

Distributors: Ashland Chemical/Solvents Division,
Valvoline Oil and Chemicals, Mississauga

Major Users: Ashland Chemicals/Solvents, Mississauga
Bayer (Canada) Inc., Mississauga
Dearborn Chemical Co. Ltd., Mississauga
International Chemicals Ltd., Brampton
Pennwalt of Canada Ltd., Oakville
Perolin-Bird Archer Co. Ltd., Cobourg
Quatic Chemicals Ltd., Guelph

1,4-DICHLOROBENZENE

Manufacturers: Only manufactured in Quebec and British Columbia by Record Chemical Co. Inc.,
Burnaby, British Columbia
Napierville, Quebec
St. Laurent, Quebec

Distributors: None listed

Major Users: Bayer (Canada) Inc., Mississauga
Dow Chemical of Canada Ltd., Sarnia
International Chemicals Ltd., Brampton

DICHLOROMETHANE

Manufacturers: Dow Chemical of Canada Ltd., Sarnia
(sole manufacturer in Canada)

Distributors: Dow Chemical of Canada Ltd., Sarnia
(imported from U.S.A.)
Kingsley & Keith (Canada) Ltd., Etobicoke
(imported from Belgium, France, Netherlands
and West Germany)

Major Users: Alloycraft Ltd., Toronto
Apco Industries Ltd., Toronto
Armalite Co. Ltd., Toronto
Ashland Chemicals/Solvents, Mississauga
Bartek Chemical, Burlington
Bate Chemical Co. Ltd., Don Mills
Canada Colours & Chemicals Ltd., Toronto
Conn Chem Group Ltd., Toronto
Cromac Chemical Co. Ltd., Toronto
Davidson Rubber Co. Ltd., Port Hope
Dominion Cisco Industries Ltd., Toronto
Harrisons & Crosfield Ltd., Toronto
Hoover Chemicals Ltd., Tillsonburg
Kingsley & Keith Ltd., Toronto
Reeve Bros. Canada Ltd., Toronto
S.F. Lawrason's Chemicals Ltd., London
Van Waters & Rogers Ltd., Toronto & Guelph
Western Solvents & Chemicals (Canada) Ltd.,
Weston
Woodbridge Foam Corp., Woodbridge

2,4-DICHLOROPHENOXYACETIC ACID (2,4-D)

Manufacturers: Only manufactured in Alberta
Uniroyal Chemical, Division of Uniroyal
Ltd., Sherwood Park

Distributors: Atlantic Trading, Toronto
(imported from Denmark)
Bayer (Canada) Inc., Mississauga
(imported from West Germany)
Dow Chemical of Canada Ltd., Sarnia
(imported from U.S.A.)
Kingsley & Keith Ltd., Toronto
(imported from U.K.)

Major Users: Ciba-Geigy Ltd., Cambridge
Harrisons & Crosfield Ltd., Toronto
Monsanto Canada Inc., Mississauga
Pfizer Canada Inc., Sarnia

DIISOBUTYLENE

Manufacturers: Polysar Ltd., Sarnia

Distributors: None listed

Major Users: None listed

DIPHENYLAMINE

Manufacturers: Not manufactured in Canada

Distributors: None listed

Major Users: Bayer (Canada) Inc., Mississauga
Cyanamid of Canada Ltd., Mississauga

DIPHENYL METHANE 4,4-DIISOCYANATE

Manufacturers: Not manufactured in Canada

Distributors: Bayer (Canada) Inc., Mississauga
C.I.L., Toronto
(imported from U.S.A.)

Major Users: Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Mississauga
C.I.L., Mississauga
Canadian General Electric Co. Ltd., Toronto
General Latex & Chemicals Ltd., Brampton
Iroquois Chemicals Ltd., Cornwall
Poly Rim Ltd., Thornhill
Schenectady Chemicals Canada Ltd.,
Scarborough
Witco Chemicals Ltd., Oakville

EPICHLOROHYDRIN

Manufacturers: Not manufactured in Canada

Distributors: Dow Chemical of Canada Ltd., Sarnia
B.F. Goodrich Chemical Products, Kitchener
(imported from U.S.A.)

Major Users: Dow Chemical of Canada Ltd., Sarnia
B.F. Goodrich Canada Ltd., Kitchener
International Chemicals Ltd., Brampton
Shell Canada Ltd., Sarnia

ETHYLBENZENE

Manufacturers: Polysar Ltd., Sarnia
(sole manufacturer in Canada)

Distributors: None listed

Major Users: International Chemicals Ltd., Brampton

ETHYL CHLORIDE

Manufacturers: Ethyl Canada Inc., Corunna
(sole manufacturer in Canada)

Distributors: None listed

Major Users: Canadian Liquid Air, Toronto
Dow Chemical of Canada Ltd., Sarnia
DuPont of Canada Ltd., Maitland
Polysar Ltd., Sarnia
Shell Canada Ltd., Oakville & Sarnia

ETHYLENE DIBROMIDE

Manufacturers: Not manufactured in Canada

Distributors: Dow Chemical of Canada Ltd., Toronto
(imported from U.S.A.)

Major Users: Chorney Chemical Co. Ltd., Toronto

ETHYLENE DICHLORIDE

Manufacturers: Caledon Laboratories Ltd., Georgetown
Dow Chemical of Canada Ltd., Sarnia
Ethyl Canada Inc., Corunna
(also manufactured in Fort Saskatchewan,
Alberta)

Distributors: Dow Chemical of Canada Ltd., Sarnia
Ethyl Canada Inc., Toronto
(imported from U.S.A.)

Major Users: Canada Colours & Chemicals Ltd., Toronto
Dominion Cisco Industries Ltd., Weston
DuPont of Canada Ltd., Maitland

ETHYLENE OXIDE

Manufacturers: Dow Chemical of Canada Ltd., Sarnia
(also manufactured in Montreal, Quebec
and Alberta)

Distributors: No longer imported into Canada

Major Users: Alkaril Chemicals Ltd., Mississauga
Becton Dickenson Canada Ltd., Mississauga
Canadian Liquid Air Ltd., Toronto
Chinook Chemicals Ltd., Sombra
Diamond Shamrock Canada Ltd., Hamilton
Domtar (CDC), Longford Mills
Griffith Laboratories Ltd., Scarborough
Hart Chemicals Ltd., Guelph
Matheson of Canada Ltd., Brampton
St. Lawrence Starch Co., Mississauga

FORMALDEHYDE

Manufacturers: Borden Chemical Canada Division, Borden
Products Ltd., West Hill
North Bay
Reichhold Chemicals Ltd., North Bay
Thunder Bay

Distributors: Borden Chemical Canada Division, West Hill
Reichhold Chemicals Ltd., Toronto
(imported from U.S.A.)

Major Users: Almatex, London
Arliss Chemical Co. Inc., Toronto
Benson Chemicals Ltd., Freelon
Canada Colours & Chemicals Ltd., Toronto
C.I.L., Toronto
Canadian Occidental Petroleum, Fort Erie
Canadian General Electric Co. Ltd., Toronto
Fiberglass Canada Ltd., Sarnia
Glidden Ltd., Toronto
Goodyear Canada, Toronto
Harrisons & Crosfield Ltd., Toronto
Moore, Benjamin Ltd., Toronto
PPG Industries Canada Ltd., Toronto
Schenectady Chemicals Ltd., Toronto
S.F. Lawrason's Chemical Ltd., London

FORMIC ACID

Manufacturers: Not manufactured in Canada

Distributors: Canada Colours & Chemicals Ltd., Toronto
(imported from U.S.A.)

Major Users: A & K Petro-Chem Industries Ltd., Weston
Arliss Chemical Co. Inc., Mississauga
BASF Canada Ltd., Toronto
Benson Chemicals Ltd., Freelon
Canada Colours & Chemicals Ltd., Toronto
Kingsley & Keith Ltd., Toronto

FURFURYL ALCOHOL

Manufacturers: Not manufactured in Canada

Distributors: Ashland Chemical/Solvents Division
Valvoline Oil & Chemicals, Mississauga
Sargent-Welsh Scientific of Canada Ltd.,
Weston

Major Users: None listed

HEXAMETHYLENEDIAMINE

Manufacturers: DuPont of Canada Ltd., Maitland
(sole manufacturer in Canada)

Distributors: None listed

Major Users: None listed

HYDROCHLORIC ACID

Manufacturers: Allied Chemical Canada Ltd., Amherstburg
Dow Chemical of Canada Ltd., Sarnia
DuPont of Canada Ltd., Maitland
Reed Ltd., Chemical Division, Dryden
(also manufactured in Brandon, Manitoba;
Saskatoon, Saskatchewan; Fort Saskatchewan,
Alberta; and Squamish, North Vancouver,
British Columbia)

Distributors: Pennwalt of Canada Ltd., Oakville
(imported from U.S.A.)

Major Users: A & B Chemical Products, Stouffville
A & K Petro-Chem Industries Ltd., Weston
Algoma Steel, Sault Ste. Marie
Anachemia Ltd., Mississauga
Bate Chemical Co. Ltd., Don Mills
Benson Chemicals Ltd., Freelton
Canada Colours & Chemicals Ltd., Toronto
Canadian Hanson Ltd., Toronto
Diversey (Canada) Ltd., Mississauga
Dominion Foundries, Hamilton
Dustbane Enterprises Ltd., Ottawa
Ethyl Canada Inc., Sarnia
Kert Chemicals Ltd., Toronto
Nacan Products, Collingwood
Pennwalt of Canada Ltd., Oakville
St. Lawrence Starch Co., Mississauga
Steel Co. of Canada, Hamilton
Uba Chemical Industries Ltd., Mississauga

HYDROFLUORIC ACID

Manufacturers: Allied Chemical Canada Ltd., Amherstburg
(also manufactured in Valleyfield, Quebec)

Distributors: Pennwalt of Canada Ltd., Oakville (imported
from U.S.A.)

Major Users: Canada Colours & Chemicals Ltd., Toronto
Canadian Hanson Ltd., Toronto
DuPont of Canada Ltd., Maitland
Eldorado Nuclear, Port Hope
Gulf Canada Ltd., Mississauga
Suncor, Sarnia

HYDROGEN CHLORIDE (ANHYDROUS)

Manufacturers: Dow Chemical of Canada Ltd., Sarnia
(sole manufacturer in Canada)

Distributors: Union Carbide Canada Ltd., Toronto
(imported from U.S.A.)

Major Buyers: Air Products, Brampton
Canadian Liquid Air Co. Ltd., Toronto
Matheson of Canada Ltd., Brampton
Union Carbide Canada Ltd., Toronto

HYDROGEN FLUORIDE

Refer to HYDROFLUORIC ACID

HYDROGEN PEROXIDE

Manufacturers: Not manufactured in Canada

Distributors: DuPont of Canada Ltd., Maitland
Canada Colours and Chemicals Ltd., Toronto
(imported from U.S.A.)

Major Users: A&K Petro Chem Industries Ltd., Weston
Arliss Chemical Inc., Mississauga
Canada Colours and Chemicals Ltd., Toronto
Dominion Cisco Industries Ltd., Weston
DuPont of Canada Ltd., Toronto
International Chemical Ltd., Brampton
Pennwalt of Canada Ltd., Oakville
Pigment & Chemical Co. Ltd., Milton

HYDROGEN SULPHIDE

Manufacturers: Cornwall Chemicals (C.I.L.), Cornwall
(also manufactured in Montreal East, Quebec
and Fort Saskatchewan, Alberta)

Distributors: None listed

Major Users: Air Products, Brampton
Canadian Liquid Air Co. Ltd., Toronto
Matheson of Canada Ltd., Brampton
Ontario Hydro, (Bruce Nuclear Power Development)

MALEIC ANHYDRIDE

Manufacturers: Only manufactured in Quebec by Monsanto
Canada Ltd., La Salle

Distributors: None listed

Major Users: Bartek Chemical Co. Ltd., Burlington
Bate Chemical Co. Ltd., Don Mills
Dominion Cisco Industries Ltd., Weston
Henkel Chemicals Canada Ltd., Mississauga
International Chemicals Canada, Brampton
Quadra Chemicals Ltd., Mississauga
Stanchem, Toronto
Stormont Chemicals Ltd., Mississauga

METHYL ACRYLATE

Manufacturers: Not Manufactured in Canada

Distributors: Rohm and Haas Canada Ltd., West Hill
(imported from U.S.A.)

Major Users: BASF Canada Ltd., Toronto
CPS Chemical Canada, Toronto
Celanese Canada Inc., Toronto
International Chemical Canada, Brampton
Rohm and Haas Canada Ltd., West Hill

METHYLAMINE

Manufacturers: Chinook Chemicals Ltd., Sombra
(sole manufacturer in Canada)

Distributors: Chinook Chemicals Ltd., Sombra
(imported from U.S.A.)

Major Users: Canada Colours & Chemicals Ltd., Toronto
Ciba-Geigy Canada Ltd., Cambridge
DuPont of Canada Ltd., North Bay
DuPont of Canada Ltd., Maitland
International Chemical Canada, Brampton
Pfizer Canada, Sarnia
Uniroyal Chemical Inc., Elmira

METHYL CHLORIDE

Manufacturers: Dow Chemical of Canada Ltd., Sarnia
(sole manufacturer in Canada)

Distributors: None listed

Major Uses: Canadian Liquid Air Ltd., Toronto
DuPont of Canada Ltd., Toronto

MONOETHANOLAMINE

Manufacturers: Dow Chemical of Canada Ltd., Sarnia
(also manufactured in Fort Saskatchewan,
Alberta and Montreal, Quebec)

Distributors: None listed

Major Users: Canada Colours & Chemicals Ltd., Toronto
Diamond Shamrock Canada Ltd., Willodale
Dominion Cisco Industries Ltd., Weston
Harrison & Crosfield Ltd., Toronto
Henkel Chemical Ltd., Mississauga
International Chemical Canada, Brampton
Texaco Chemicals Canada Ltd., Toronto

MORPHOLINE

Manufacturers: Not manufactured in Canada

Distributors: Texaco Chemicals Canada Ltd., Toronto
(imported from U.S.A.)
C.I.L., Toronto
(imported from U.K.)

Main Users: Alchem Inc., Burlington
Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Mississauga
Betz Laboratories Ltd., Kanata
Bate Chemical Co. Ltd., Don Mills
Canada Colours & Chemicals Ltd., Toronto
C.I.L., Toronto
Calgon Canada Ltd., Bramalea
Dearborn Chemical Co. Ltd., Mississauga
Dominion Cisco Industries Ltd., Hamilton
Drew Chemicals Ltd., Ajax
Harrisons & Crosfield Ltd., Toronto
Perolin - Bird Archer Co. Ltd., Cobourg
Ontario Hydro, Toronto
Quatic Chemical Co. Ltd., Guelph
Uniroyal Chemicals Inc., Elmira

NAPHTHA (COAL TAR)

Manufacturers: Not manufactured in Canada

Distributors: None listed

Major Users: Apco Industries Co. Ltd., Toronto
Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Mississauga
Harrisons & Crosfield Ltd., Toronto

NAPHTHALENE

Manufacturers: Not manufactured in Ontario
Record Chemical Co. Inc., Napierville,
Quebec
Record Chemical Co. Inc., Burnaby, British
Columbia
Syndel Laboratories Ltd., Vancouver,
British Columbia

Distributors: None listed

Major Users: International Chemical Canada, Brampton

NITRIC ACID

Manufacturers: C.I.L., Nobel
Cyanamide of Canada Ltd., Niagara Falls,
DuPont of Canada Ltd., North Bay
Genstar Chemical Ltd., Maitland
(also manufactured in Beloeil, Valleyfield,
Quebec; Brandon, Manitoba; Calgary,
Redwater, Medicine Hat, Alberta)

Distributors: Monsanto Canada Ltd., Mississauga
(imported from U.S.A.)

Major Users: A & B Chemical Products, Stouffville
Allied Chemical Canada Ltd., Corruna
Allied Chemical Canada Ltd., Amherstburg
Arliss Chemical Inc., Mississauga
Benson Chemicals Ltd., Freelon
Canada Colours & Chemicals Ltd., Toronto
Uba Chemical Industries Ltd., Mississauga

OXALIC ACID

Manufacturers: Only manufactured in Quebec by Anachemia
Ltd., Ville St. Pierre

Distributors: None listed

Major Users: A & B Chemical Products, Stouffville
Allied Chemical Canada Ltd., Corunna
Allied Chemical Canada Ltd., Amherstburg
Arliss Chemical Inc., Mississauga
Bate Chemical Co. Ltd., Toronto

Canada Colours & Chemicals Ltd., Toronto
Dominion Cisco Industries Ltd., Weston
Harrisons & Crosfield Ltd., Toronto
Quadra Chemicals Ltd., Mississauga
Stormont Chemicals Ltd., Mississauga

PARAFORMALDEHYDE

Manufacturers: Not manufactured in Canada

Distributors: Celanese Canada Inc., Mississauga
(imported from U.S.A.)

Major Users: Bayer (Canada) Inc., Mississauga
Celanese Canada Inc., Mississauga
Degussa (Canada) Ltd., Burlington
Tennant Charles & Co. (Canada) Ltd., Weston

PENTACHLOROPHENOL

Manufacturers: Not manufactured in Ontario
Dow Chemical of Canada Ltd., Fort
Saskatchewan, Alberta
Uniroyal Chemical, Sherwood Park, Alberta

Distributors: Dow Chemical of Canada Ltd., Sarnia
Reichhold Ltd., Toronto
S.F. Lawrason's Chemicals Ltd., London
(imported from U.S.A.)

Major Users: Baywood Processing, Thunder Bay
Domtar Chemical, Trenton
Kirkland Wood Treatment, Dobie
Northern Wood Preserves, Thunder Bay

PERCHLOROETHYLENE

Manufacturers: Only manufactured in Ontario for captive use
Sole manufacturer is C.I.L., Shawinigan, Quebec

Distributors: Diamond Shamrock Canada Ltd., Toronto
(imported from U.S.A.)

Major Users: Canada Colours & Chemicals Ltd., Toronto
Dominion Cisco Industries Ltd., Weston
Harrisons & Crosfield Ltd., Toronto
International Chemicals Ltd., Brampton
S.F. Lawrason's Chemicals Ltd., London

PHENOL

Manufacturers: Not manufactured in Ontario
Dow Chemical of Canada Ltd., Ladner, British Columbia
Gulf Canada Ltd., Montreal, Quebec

Distributors: Dow Chemical of Canada Ltd., Sarnia
U.S. Steel International Ltd., Toronto
(imported from U.S.A.)

Major Users: Ashland Chemical/Solvent Division, Valvoline
Oil & Chemicals, Mississauga
Bakelite Thermosets, Belleville
Bayer (Canada) Inc., Mississauga
Borden Chemical Canada, North Bay
Canadian General Electric Inc., Toronto
Canadian Occidental Petroleum Ltd., Fort Erie
Domtar (CDC Division), Longford Mills
Fibreglass Canada Ltd., Sarnia
Hart Chemical Ltd., Guelph
Lawter Chemicals (Canada) Ltd., Toronto
Reichhold Ltd., North Bay, Thunder Bay
Schenectady Chemicals Ltd., Toronto
Uniroyal Chemical, Elmira

PHOSPHORIC ACID

Manufacturers: C.I.L., Courtright
Erco Industries Ltd., Port Maitland
International Minerals & Chemicals
Corp. (Canada) Ltd., Port Maitland
(also manufactured in Buckingham, Quebec;
Redwater, Fort Saskatchewan, Medicine
Hat, Alberta; Kimberley, Trail, British
Columbia)

Distributors: Harrisons & Crosfield Ltd., Toronto
Monsanto Canada Ltd., Mississauga
(imported from U.S.A.)

Major Users: A&K Petro Chem Industries Ltd., Weston
Allied Chemical Canada Ltd., Corunna
Arliss Chemical Inc., Mississauga
Arliss Chemical Inc., Amherstburg
Bate Chemical Co. Ltd., Don Mills
Benson Chemicals Ltd., Freelon
Canada Colours & Chemicals Ltd., Toronto
Canadian Hanson Ltd., Toronto
International Chemical Canada, Brampton
Kingsley & Keith Ltd., Toronto
Quadra Chemicals Ltd., Mississauga
Uba Chemical Industries Ltd., Mississauga

PHOSPHORUS

Manufacturers: Erco Industries Ltd., Toronto
(also manufactured in Buckingham, Quebec)

Distributors: Monsanto Canada Ltd., Mississauga
(imported from U.S.A.)

Major Users: None listed

POLYCHLORINATED BIPHENYLS (PCB)

Not manufactured or distributed in Canada, since 1979.

n-PROPYL ALCOHOL

Manufacturers: Caledon Laboratories Ltd., Georgetown
(sole manufacturer in Canada)

Distributors: None listed

Major Users: Anachemia Ltd., Mississauga
Arliss Chemical Inc., Mississauga
Ashland Chemical/Solvent Division,
Valvoline Oil & Chemicals, Mississauga
BASF Canada Ltd., Toronto
Bate Chemical Co. Ltd., Don Mills
Eastman Chemical International Ltd., Don Mills
Harrisons & Crosfield Ltd., Toronto
Harrisons & Crosfield Ltd., Don Mills

PROPYLENE OXIDE

Manufacturers: Dow Chemical of Canada Ltd., Sarnia
(sole manufacturer in Canada)

Distributor: None listed

Major Users: None listed

SODIUM CYANIDE

Manufacturers: Park Thermal Ltd., Georgetown
(sole manufacturer in Canada)

Distributors: A&K Petro-Chem Industries Ltd., Weston
CIL, Toronto
Canada Colours and Chemicals Ltd., Toronto
Canadian Hanson Ltd., Toronto
Chemsolve Ltd., Willowdale
Degussa (Canada) Ltd., Burlington
Harrisons and Crosfield (Canada) Ltd., Toronto
Kingsley and Keith Ltd., Toronto
M&T Chemicals Ltd., Hamilton
(imported from U.K., West Germany, Japan and U.S.A.)

Major Users:

Campbell Red Lake, Balmertown
Dickenson Mines, Red Lake
Dome Mines, South Porcupine
Inco, Copper Cliff
Kerr Addison Mines, Temiskaming
Noranda Mines, Manitouwadge
Pamour Porcupine Mines, Pamour
TexasGulf, Timmins
Willroy Mines, Kirkland Lake

STYRENE

Manufacturers:

Dow Chemical of Canada Ltd., Sarnia
Polysar Ltd., Sarnia
(only manufacturers in Canada)

Distributors:

Not imported since 1979

Major Users:

Alcore Fabricating Ltd., Richmond Hill
Almatex Ltd., London
Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Cobourg
Canadian General Electric Co. Ltd., Toronto
C.I.L., Toronto
CPS Chemical Canada Ltd., Toronto
Dominion Cisco Industries Ltd., Weston
DuPont of Canada Ltd., Ajax
Fibreglass Canada Ltd., Guelph
Glidden Co. (SCM) Canada Ltd., Toronto
Inmont Canada Ltd., Windsor
Iroquois Chemicals Ltd., Cornwall
S.C. Johnson & Son Ltd., Brantford
Mia Chemical Ltd., Mississauga
Moore, Benjamin Ltd., Toronto
Polyresins Ltd., Toronto
Protective Plastics Ltd., Milliken
Reichhold Ltd., Weston, Toronto, Thunder Bay
Rohm & Haas Canada Ltd., West Hill
Schenectady Chemicals Ltd., Toronto
Temuss Products Canada Ltd., Ajax

SULPHUR DIOXIDE

Manufacturers: INCO (formally C.I.L.), Copper Cliff
(also manufactured in Trail, B.C.)

Distributors: Not imported since 1980

Major Users: American Can of Canada Ltd., Marathon
Boise Cascade Canada Ltd., Fort Frances
Canadian Liquid Air Co. Ltd., Hamilton,
Sarnia, Toronto
Domtar Inc., Hamilton, Sault Ste. Marie,
Longford Mills
Eddy Forest Products Ltd., Espanola
Great Lakes Forest Products Ltd., Dryden
Matheson of Canada Ltd., Whitby
Noranda Mines Co., Manitouwadge
Ontario Paper Co. Ltd., Thorold
Spruce Falls Power, Kapuskasing
Tembec Forest Products Ltd., Temiskaming
Texasgulf Inc., Metals Division, Timmins

SULPHUR MONOCHLORIDE

Manufacturers: Not manufactured in Canada

Distributors: Canada Colours & Chemicals Ltd., Toronto
(imported from U.S.A.)

Major Users: None listed

SULPHURIC ACID

Manufacturers: C.I.L., Courtright
C.I.L., Nobel
Cyanamid of Canada Ltd., Niagara Falls
DuPont of Canada Ltd., North Bay
Falconbridge Nickel Mines Ltd., Sudbury
INCO (formally C.I.L.), Copper Cliff
International Minerals and Chemicals Corp.
Canada Ltd., Port Maitland
Sulco Chemicals Ltd., Elmira
Texasgulf Inc. Metals Division, Timmins
(also manufactured in Belledune, New
Brunswick; Valleyfield, Beloeil,
Murdocville, Quebec; Transcona, Manitoba;
Rabbit Lake, Saskatoon, Saskatchewan;
Medicine Hat, Fort Saskatchewan, Redwater,
Calgary, Alberta; Kimberley, Trail,
Prince George, B.C.)

Distributors: Allied Chemical Canada, Mississauga
C.I.L., Toronto
Noranda Mines Co., Toronto
(imported from U.S.A.)

Major Users: Abitibi-Price Co. Ltd., Smooth Rock Falls
Alcan Smelters & Chemicals Ltd., Jonquiere
Agnew Lake Mines, Agnew, Lake Ontario
Algoma Steel Co. Ltd., Sault Ste. Marie
Allied Chemical Canada Ltd., Amherstburg
Allied Chemical Canada Ltd., Corruna
American Can of Canada Ltd., Marathon
Bate Chemical Co. Ltd., Don Mills
Bayer (Canada) Inc., Mississauga
Benson Chemicals Ltd., Freelon
B.P. Refinery Canada Ltd., Oakville
Canadian Hanson Ltd., Toronto
Colgate Palmolive Co., Toronto
Courtaulds (Canada) Inc., Cornwall
Denison Mines Ltd., Elliot Lake
Diversey Foundaries Ltd., Hamilton
Domtar Inc., Cornwall
Eddy Forest Products Ltd., Espanola
Great Lakes Forest Products, Thunder Bay
Great Lakes Forest Products, Dryden
Harrisons & Crosfield Ltd., Toronto
INCO, Copper Cliff
Kimberly-Clark of Canada Ltd., Terrace Bay
Lever Detergents Ltd., Toronto
Madawaska Mines Ltd., Bancroft
Ontario Paper Co. Ltd., Thorhold
Procter & Gamble Inc., Hamilton
Rio Algom Ltd., Elliot Lake
Shell Canada Ltd., Oakville
Steel Co. of Canada Ltd., Hamilton
Uba Chemical Industries Ltd., Mississauga

TETRAETHYL LEAD

Manufacturers: Dupont of Canada Limited, Maitland
Ethyl Corporation of Canada Limited, Corunna
(only manufacturers in Canada)

Distributors: Not imported into Canada

Major Users: BP Refinery Canada Ltd., Oakville
Gulf Canada Ltd., Mississauga
Imperial Oil Ltd., Sarnia
Shell Canada Ltd., Sarnia, Corunna, Oakville,
Simcoe
Sunoco Inc., Sarnia
Texaco Canada Inc., Mississauga

TETRAMETHYL LEAD

Manufacturers: Dupont of Canada Ltd., Maitland
Ethyl Corporation of Canada Ltd., Corunna

Distributors: None listed

Major Users: None listed

TITANIUM TETRACHLORIDE

Manufacturers: Not manufactured in Canada

Distributors: Kingsley & Keith (Canada) Ltd., Toronto
(imported from U.S.A.)

Major Users: None listed

TOLUENE

Manufacturers: Caledon Laboratories Ltd., Georgetown
Dow Chemical of Canada Ltd., Sarnia
Esso Chemical Canada, Sarnia
Petrosar Ltd., Corunna
Polysar Canada Ltd., Corunna
Sunchem, Division of Sunoco Inc., Sarnia
Texaco Canada Ltd., Mississauga
(also manufactured in Ioco, British
Columbia and Pointe-Aux-Trembles, Quebec)

Distributors: Only imported to companies outside of
Ontario from U.S.A.

Major Users:

A&K Petro-Chem Industries Ltd., Weston
Almatex Ltd. London
Anachemia Ltd., Mississauga
Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Mississauga
Bate Chemical Ltd., Don Mills
Borden Chemical Division, Borden Co.,
Toronto, North Bay, Cobourg
C.I.L., Toronto
Canada Colours & Chemicals Ltd., Toronto
Canada Printing Ink Co. Ltd., Toronto
Desoto Coatings Ltd., Toronto
Dominion Cisco Industries Ltd., Weston
Dupont of Canada Ltd., Ajax
Dupont of Canada Ltd., Corunna
Ford Motor Co. of Canada Ltd., Oakville
General Motors of Canada Ltd., Oshawa
Harrisons & Crosfield Ltd., Toronto
Hart Chemical Ltd., Guelph
Industrial Adhesives Ltd., Toronto
Inmont Canada Ltd., Toronto, Brantford
Lawter Chemicals Canada Ltd., Toronto
Mobile Chemical Canada Ltd., Coatings
Division, Toronto
PPG Industries Canada Ltd., Mississauga
PPG Industries Canada Ltd., Toronto
Sinclair & Valentine Ltd., Toronto
3M Ltd., London
Tonecraft Ltd., Toronto
Toronto Star Newspapers Ltd., Toronto

TOLUENE 2,4-DIISOCYANATE

Manufacturers:

Not manufactured in Canada

Distributors:

Allied Chemical Canada Ltd., Corunna
BASF Canada Ltd., Toronto
Bayer (Canada) Inc., Mississauga
C.I.L., Toronto
Dow Chemical Canada Ltd., Sarnia
Union Carbide of Canada Ltd., Toronto
(imported from U.S.A.)

Major Users:

Able Plastics Ltd., Bramalea
Chemroy Chemicals Ltd., Mississauga
Davidson Rubber Co. Ltd., Port Hope
Delaney & Pettit Ltd., Ajax
Dynaflex Plastics Ltd., Port Hope
Henkel Chemicals Canada Ltd., Mississauga
Hoover Chemical Ltd., Tillsonburg
International Chemical Canada, Brampton
Reeves Bros. (Canada) Ltd., Toronto
Vitafoam Products Ltd., Toronto
Woodbridge Foam Corp., Woodbridge

1,1,1-TRICHLOROETHANE

Manufacturers:

Dow Chemical of Canada Ltd., Sarnia
(sole manufacturer in Canada)

Distributors:

Dow Chemical of Canada Ltd., Sarnia
(imported from U.S.A.)

Major Users:

A&K Petro-Chem Industries Ltd., Weston
Alloycraft Ltd., Toronto
Apco Industries Co. Ltd., Toronto
Armalite Co. Ltd., Toronto
Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Mississauga
Bate Chemical Co. Ltd., Don Mills
Canada Colours & Chemicals Ltd., Toronto
Canadian Hanson Ltd., Toronto
Cromac Chemical Co. Ltd., Toronto
Dominion Cisco Industries Ltd., Weston
Harrisons & Crosfield Ltd., Toronto
International Chemical Canada Ltd., Toronto
Western Solvents & Chemicals (Canada) Ltd.,
Weston

TRICHLOROETHYLENE

Manufacturers:

Caledon Laboratories Ltd., Georgetown
(also manufactured in Shawinigan, Quebec)

Distributors:

Allied Chemical Canada Ltd., Mississauga
Kingsley & Keith Ltd., Toronto

Major Users: A&K Petro-Chem Industries Ltd., Weston
Alloycraft Ltd., Toronto
Apco Industries Ltd., Toronto
Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Mississauga
Bate Chemical Ltd., Don Mills
Canada Colours & Chemical Ltd., Toronto
Canadian Hanson Ltd., Toronto
Canada Colours & Chemical Ltd., Toronto
Cromac Chemical Co. Ltd., Toronto
Dominion Cisco Industries Ltd., Weston
Dow Chemical of Canada Ltd., Sarnia
Harrisons & Crosfield Ltd., Toronto
International Chemical Canada Ltd.,
Brampton
Kingsley & Keith Ltd., Toronto
Western Solvents & Chemicals (Canada) Ltd.,
Toronto

VANADIUM PENTOXIDE

Manufacturers: Not manufactured in Ontario
Union Carbide of Canada Ltd., Metals Division,
Beauharnois, Quebec

Distributors: None listed

Major Users: Canada Colours & Chemicals Ltd., Toronto
Pigment & Chemical Ltd., Milton
Union Carbide Canada Ltd., Toronto

VINYL ACETATE

Manufacturers: Not manufactured in Ontario
Celanese Canada Inc., Edmonton, Alberta

Distributors: Borden Chemical Division, Borden Co.,
West Hill
Celanese Canada Inc., Toronto
Nacan Products Ltd., Toronto
Union Carbide Canada Ltd., Toronto
(imported from U.S.A.)

Major Users: Ashland Chemicals/Solvents Division,
Valvoline Oil & Chemicals, Mississauga
Borden Chemical Co., West Hill
Glidden Ltd., Toronto
B.F. Goodrich Canada Ltd., Niagara Falls
International Chemical Canada Ltd., Brampton
Moore, Benjamin Ltd., Toronto
Polyresins Ltd., Toronto
Reichhold Ltd., Toronto
St. Lawrence Chemical Co. Ltd., Toronto
Stein-Hall Ltd., West Hill

VINYL CHLORIDE

Manufacturers: Dow Chemical of Canada Ltd., Sarnia
(also manufactured in Fort Saskatchewan,
Alberta)

Distributors: Dow Chemical of Canada, Sarnia
(imported from U.S.A.)

Major Uses: Esso Chemical Canada Ltd., Sarnia
B.F. Goodrich Canada Ltd., Niagara Falls
Kingsley & Keith Ltd., Toronto
PPG Industries Canada Ltd., Toronto
PPG Industries Canada Ltd., Mississauga

XYLENE

Manufacturers: Domtar Chemicals Group, CDC Division,
Hamilton
Esso Chemical Canada, Sarnia
Petrosar Ltd., Corunna
Shell Canada Ltd., Corunna
Sunchem, Division of Sunoco Inc., Sarnia
Texaco Canada Ltd., Mississauga

Distributors: Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Mississauga

Major Users: Almatex Ltd., London
Ashland Chemical/Solvents Division,
Valvoline Oil & Chemicals, Mississauga
Bate Chemical Ltd., Don Mills
BASF Canada Ltd., Cornwall
Borden Chemical Co., West Hill
C.I.L., Toronto
Canada Colours & Chemicals Ltd., Toronto

Desoto Coatings Ltd., Toronto
 Dominion Cisco Industries Ltd., Weston
 Dominion Cisco Industries Ltd., Hamilton
 DuPont of Canada Ltd., Ajax
 General Motors of Canada Ltd., Oshawa
 Glidden (SCM) Ltd., Toronto
 Glidden (SCM) Ltd., Brampton
 Harrisons & Crosfield Ltd., Toronto
 Hart Chemicals Ltd., Guelph
 Inmont Canada Ltd., Toronto
 Inmont Canada Ltd., Brantford
 Industrial Adhesives Ltd., Toronto
 Lawter Chemicals Canada Ltd., Toronto
 Mobil Chemical Canada Ltd., Toronto
 PPG Industries Ltd., Mississauga
 Sinclair & Valentine Ltd., Toronto
 3M Ltd., London
 Tonecraft Ltd., Toronto
 Toronto Star Newspapers Ltd., Toronto

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